UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

October 21, 2003

Magalie R. Salas, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

RE: Endangered Species Act Section 7 Consultation: Final Biological Opinion on the Bull Run Hydroelectric Project (No. 477-024) application to amend current license to extend the term of license and subsequently surrender the project. NOAA Fisheries Consultation F/NWR/2003/01249.

Dear Secretary Salas:

Enclosed is the final Biological Opinion (Opinion) prepared by the National Marine Fisheries Service (NOAA Fisheries) on the Federal Energy Regulatory Commission's (FERC) proposed license extension and subsequent license surrender for the Bull Run Hydroelectric Project (the Project). This document represents NOAA Fisheries' biological opinion of the effects of the proposed action on listed species in accordance with Section 7 of the Endangered Species Act of 1973 (ESA) as amended (16 USC 1531 *et seq.*). This Opinion is also being provided to Portland General Electric (PGE) as FERC's designated non-Federal representative.

In this Opinion, NOAA Fisheries has determined that the proposed action is not likely to jeopardize the continued existence of ESA-listed Lower Columbia River chinook salmon and Lower Columbia River steelhead. A complete administrative record of this consultation is on file with the NOAA Fisheries Hydropower Division in Portland, Oregon.

In addition, enclosed as Section 11 of the Opinion is a consultation regarding essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). NOAA Fisheries finds that the proposed action will adversely affect EFH for chinook salmon and coho and recommends that the Terms and Conditions of Section 8 of the Opinion be adopted as EFH conservation measures. Pursuant to MSA (§305(b)(4)(B) and 50 CFR 6000.920(j), Federal agencies are required to provide a written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations.

NOAA Fisheries believes that amendment of the license, and subsequent surrender and decommissioning of the Project, will ultimately restore riverine processes and improve fish passage in the Sandy River Basin. Nonetheless, NOAA Fisheries believes that continued operation of the Project until 2007, and activities and effects associated with the decommissioning and removal of the Project, may result in the incidental take of Lower Columbia River chinook salmon and Lower Columbia River steelhead. Accordingly, we have provided a set of nondiscretionary reasonable and prudent measures (RPM) in the accompanying Opinion which we believe will be necessary to minimize the likelihood of incidental take.

On September 29, 2003, NOAA Fisheries provided a draft biological opinion on FERC's proposed license extension and subsequent license of the Project. On October 16, 2003, FERC issued a letter to NOAA Fisheries offering no comments on the draft biological opinion.

Thank you for your concern for listed species, and for your cooperation in the development of this biological opinion. If you have any comments or require additional information, please contact Keith Kirkendall of the Hydropower Division at 503-230-5431.

Sincerely,

D. Robert Lohn

D. Robert Lohn
Regional Administrator

Enclosure

cc: Julie Keil, Portland General Electric
FERC Service List

Endangered Species Act
Section 7 Consultation

Biological Opinion

and

Magnuson-Stevens Fishery Conservation and Management Act Consultation

Bull Run Hydroelectric Project
FERC Project No. 477-024

Action Agency:	Federal Energy Regulatory Commission
Consultation Conducted by:	NOAA Fisheries Northwest Region Hydropower Division
NOAA Fisheries Log Number:	F/NWR/2003/01249
Date:	October 21, 2003

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1. BACKGROUND AND CONSULTATION HISTORY

1.1 Background

This is an interagency consultation between the Federal Energy Regulatory Commission (FERC) and the National Marine Fisheries Service (NOAA Fisheries) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) and Section 305(b) of the Magnuson-Stevens Act (MSA). NOAA Fisheries is responsible for administration of the ESA with respect to anadromous salmonids. NOAA Fisheries is likewise responsible for administration of the MSA and consultations conducted pursuant to the MSA's essential fish habitat (EFH) consultation requirements.

Section 7(a)(2) of the ESA requires Federal agencies to ensure their actions avoid jeopardizing listed species or adversely modifying designated critical habitat. Section 305(b)(2) of the MSA requires Federal agencies to consult with NOAA Fisheries if their actions may adversely affect designated EFH. The Federal Power Act (FPA) authorizes FERC to license certain privately owned and operated hydroelectric projects. FERC may likewise condition such licenses for the protection and mitigation of environmental resources, including listed species and designated habitats. Consequently, FERC must initiate consultation with NOAA Fisheries under the foregoing statutes if it determines its actions may affect ESA-listed species, or may adversely affect designated EFH.

Portland General Electric (PGE) owns and operates the Bull Run Hydroelectric Project (FERC Project No. 477), located on the Sandy, Little Sandy, and Bull Run Rivers in Clackamas County, Oregon. The Project consists of two diversion dams (Marmot and Little Sandy), several water conveyance structures, a forebay (Roslyn Lake), and the 22-MW Bull Run Project Powerhouse. PGE holds the FERC license for the Bull Run Hydroelectric Project, hereinafter referred to as the Project.

FERC, under the authority of the FPA, may issue licenses for 30 to 50 years for the construction, operation, and maintenance of non-Federal hydroelectric projects. Moreover, the FPA allows licensees to voluntarily surrender existing licenses to FERC and cease operation of their facilities. The current license for the Project was issued by FERC on May 1, 1980, with an effective date of November 17, 1974, and an expiration date of November 16, 2004.

On September 1, 1998, pursuant to 18 CFR 4.34 (I), PGE filed a request to use an alternative licensing process for filing an application for relicensing of the Project, which was granted by FERC on December 10, 1998. The alternative licensing process combines the pre-filing consultation process with FERC's post-filing NEPA environmental review process. NOAA Fisheries was an active participant in this process. FERC designated PGE as a non-Federal representative to conduct informal consultation on October 15, 1999.

During relicensing, PGE determined that the likely cost of environmental protection, mitigation, and enhancement measures associated with the proposed relicensing would make continued operation of the Project uneconomical. Accordingly, on May 26, 1999, PGE announced its decision to surrender its operating license and to decommission the Project. On November 12, 1999, PGE filed a notice of its intent not to seek a new license for the Project. On March 2, 2000, FERC issued a public notice of PGE's filing, in which FERC stated:

> "If the licensee does not, by two years prior to the expiration of the current license, file an application to surrender the current license, the Commission will apply the relicense competition procedures set forth in its regulations at 18 CFR 16.25 (1999)."

At that time, PGE intended to undertake Project decommissioning and removal on an expedited basis that would have led to Project removal by the time the license expired. PGE continued the alternative process that it had been using to relicense the Project. During this process, in which NOAA Fisheries continued to be an active participant, various removal methodologies were analyzed and a draft decommissioning plan was prepared. During discussions with stakeholders, however, PGE determined that the Project could not be removed on the proposed schedule and abandoned its efforts to remove the Project on an expedited timeline.

In December 2001, at the request of key Federal and State agencies, including NOAA Fisheries, PGE convened a meeting to determine if it would be possible to reach agreement on the terms by which the Project could be decommissioned. Such an agreement would enable PGE to meet the deadline established by FERC's March 2000 notice, and would eliminate the possibility that FERC would consider the Project an "orphan" as provided in 18 CFR 16.25. If the Project were to be "orphaned," it might continue to operate under ownership other than PGE.

The December 2001 meeting, which was attended by NOAA Fisheries and 21 other agencies and organizations, led PGE to retain a mediator to structure a process by which an agreement to decommission the Project could be reached. To facilitate the decommissioning process, the parties established a Bull Run Decommissioning Working Group (DWG), and numerous issue-oriented subgroups, which met and negotiated regularly from January until October 2002 to develop a mutually acceptable settlement agreement and decommissioning plan, as well as the documents that FERC would require in support of such a filing. These negotiations were designed to address the concerns of all interested parties. This effort was successful and resulted in the Surrender Application, Settlement Agreement (SA), Decommissioning Plan, and a Biological Evaluation (BE).

The representatives of the 22 organizations that made up the DWG consistently showed leadership and a commitment to a collaborative approach that resulted in an innovative program that effectively analyzed the risk of dam removal and dealt with those risks. The DWG worked on an extremely aggressive timeline, necessitating real-time use of technical expertise. Scientists and engineers were integrated into the group's discussions so that their expertise could help shape the solutions being discussed. In addition, the use of these technical experts allowed the group to develop several innovative tools to understand and manage impacts and risks. It also allowed the DWG to have confidence that it was relying on the best science available and could move forward to make difficult decisions.

One of the subgroups established by the DWG was the ESA Subgroup, which consisted of experts from PGE, NOAA Fisheries, U.S. Fish and Wildlife Service (USFWS), and Oregon Department of Fish and Wildlife (ODFW). This ESA Subgroup met to develop actions that would serve to further minimize incidental take of fish species listed as threatened or endangered under the ESA that would otherwise result from dam operations, the surrender of the present license, and dam removal. The ESA Subgroup also considered actions to reduce impacts of dam removal on listed fish habitat in the Sandy River Basin. The intent of these discussions was to identify post-removal actions and “front-load” the ESA consultation process, thereby addressing the ESA requirement to minimize incidental take of ESA-listed fish species. With that in mind, actions which would address the requirements of the ESA by providing protection for listed species prior to, during, and following the removal of the Project facilities were developed and integrated into PGE’s final proposed action. The ESA Subgroup also assisted with review and modification of the final proposed action, effects analysis, and other contents of the final PGE BE.

The most difficult and complex part of the negotiations was determining the removal methodology of Marmot Dam and those sediments impounded by the dam. Initially, several removal strategies were under consideration. Meeting frequently from January until September 2002, the ESA Subgroup, using the best available science and technical expertise, determined which removal methodology will minimize impacts on the Sandy River, given engineering feasibility evaluations and human safety considerations.

Once the Marmot Dam removal strategy had been determined, the ESA Subgroup developed contingency measures that will further minimize incidental take of listed species during three phases of Project removal: 1) from filing of the surrender application to license expiration (2002-2004); 2) from license expiration to initiation of Project removal (2004-2007); and 3) from initiation of Project removal until completion of post-removal monitoring (2007-2012, but possibly continuing until 2017). These three phases were then used to determine the proposed ESA action that was submitted within the Biological Assessment (BA), and which has become the subject of ESA Section 7 consultation (see Section 1.2 below).

The ESA Subgroup’s contingency measures and numerous incidental take minimization actions were incorporated into the ESA Fish Monitoring and Contingency Plan (ESA Fish Plan), which is described in detail in section 4.6 of the Decommissioning Plan, and in section 3.4 of the BA. A major component of the ESA Fish Plan is the formation of the ESA Fish Monitoring and Implementation Team (MIT). PGE, ODFW, NOAA Fisheries, and USFWS will each designate a representative to the MIT, which will oversee the implementation of the ESA Fish Plan, as well as the PGE Endpoint Monitoring Plan, which is described in section 3.4.2 of the BA and section 4.7 of the Decommissioning Plan. The MIT will minimize incidental take of listed species, while allowing for modification in the monitoring activities as appropriate based on current information. The continued input of the MIT to these future monitoring plans ensures that decisions to implement protective measures for listed species will be based on the most up-to-date information, and be relevant to the situation at hand.

The overall Project decommissioning action as proposed by the SA was developed in an effort to eliminate, or reduce to the extent possible, potential impacts to listed species and minimize incidental take of these species.

1.2 ESA Section 7 and MSA 305(b)Consultation

FERC concluded in its Request for Formal Consultation letter of April 11, 2003, that decommissioning the Project under the terms of the SA (the proposed action) is likely to adversely affect Lower Columbia River (LCR) chinook salmon (*Oncorhynchus tshawytscha*) and LCR steelhead (*O. mykiss*). FERC requested initiation of formal Section 7 consultation on this basis. In addition, in that same letter, FERC concurred with the analysis in the draft BE and requested that the draft BE serve as its BA under 50 CFR §402.12. FERC's request for formal consultation was received by NOAA Fisheries on April 17, 2003, and consultation was initiated that day. Accompanying the request for consultation, FERC asked to review a draft copy of the biological opinion.

NOAA Fisheries met on September 8, 2003, with the Applicant and USFWS to review the draft Incidental Take Statement's Reasonable and Prudent Measures (RPM) and implementing Terms and Conditions. The Applicant viewed the draft RPMs and Terms and Conditions as consistent with the SA, and as further refinement of the details for actions already proposed in the settlement. Hence, the Applicant has agreed to the draft RPMs and Terms and Conditions.

A draft biological opinion was shared with FERC, and the U.S. Fish and Wildlife Service on September 29, 2003. On October 16, 2003, FERC issued a letter to NOAA Fisheries offering no comments on the draft biological opinion.

This Biological Opinion (Opinion) analyzes the potential effects of the proposed action on two listed evolutionarily significant units (ESU), threatened LCR chinook salmon and threatened LCR steelhead. This Opinion also considers the effects of the proposed action on designated EFH in the Sandy River Basin.

The objective of this Opinion is to determine whether continued Project operations and associated decommissioning, maintenance, and enhancement actions contained in the SA are likely to jeopardize the continued existence of LCR chinook salmon and LCR steelhead. As explained below in Section 5, NOAA Fisheries evaluates the impact of the Project on habitat in its jeopardy analysis.

FERC also concluded that the proposed action is likely to adversely affect LCR/Southwest Washington coho salmon and asked for conferencing for the species. NOAA Fisheries notes that the Section 7 regulations do not require conferencing on candidate species, only proposed species. Conferencing is required for proposed species when the Action Agency determines that its action is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat. There is no need to confer further on the LCR/Southwest Washington coho salmon since it has no listing status.

This Opinion does not include a critical habitat analysis, because critical habitat designations for these ESUs were vacated by court order. On February 16, 2000, NOAA Fisheries designated critical habitat for 19 ESUs of chinook, chum, and sockeye salmon, as well as steelhead, in Washington, Oregon, Idaho, and California. On September 27, 2000, NOAA Fisheries approved Amendment 14 to the Pacific Coast Salmon Fishery Management Plan designating marine and freshwater EFH for Pacific salmon pursuant to the MSA. Shortly after these designations, the National Association of Homebuilders filed a lawsuit challenging the designations on a number of grounds. On April 30, 2002, the United States District Court for the District of Columbia adopted a consent decree resolving the claims in the lawsuit. Pursuant to that consent decree, the Court issued an order vacating the critical habitat designations, but retaining the MSA EFH designations. National Association of Homebuilders, et al. v. Evans, Civil Action No. 00-2799 (CKK)(D.D.C., April 30, 2002). Thus, the critical habitat designation for LCR salmon and steelhead are no longer in effect. NOAA Fisheries intends to reissue critical habitat designations. Reinitiation of consultation will be required if the proposed action affects critical habitat designated after consultation has been completed (50 CFR §402.16(d)).

An additional objective of this Opinion is to accurately assess whether the proposed action may result in substantial adverse effects on EFH, and if so, to provide conservation recommendations to assist FERC in meetings its obligations under §305(b)(4) of the MSA.

This Opinion addresses the direct and indirect effects of the proposed action, along with effects that are interrelated or interdependent to the proposed action. Included are the effects of interim Project operations and interim conservation measures contained in the SA that are presently being implemented by PGE prior to FERC's final decommissioning order.

Also included in this analysis are the long-term effects of the proposed action, including interim Project operations, decommissioning and removal of the Project, and subsequent monitoring, together with associated SA measures proposed for inclusion in an amended license. Consequently, the scope of this Opinion is broad, and includes both interim and long-term actions and measures contained in the SA and described as the preferred alternative in the draft environmental impact statement (DEIS). Project operations and measures contained in these documents commenced upon the SA's signature in October 2002, and extend until 2017.

1.3 Approach

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined by 50 CFR §402.02 (the consultation regulations). In conducting analyses of habitat-altering actions under Section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations:

1. Consider the status and biological requirements of the species at the ESU level and within the particular action area (Section 4).
2. Evaluate the relevance of the environmental baseline in the action area to action-area biological requirements and the species' current range wide and action-area status (Section 4).
3. Determine the effects of the proposed or continuing action on the species (Section 5).
4. Consider cumulative effects (Section 6).
5. Evaluate whether the effects of the proposed action, taken together with any cumulative effects and added to the environmental baseline, can be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the affected species, or is likely to destroy or adversely affect their designated critical habitat (Section 7). (See CFR §402.14(g).)

In completing step 5, NOAA Fisheries determines whether the action under consultation, together with all cumulative effects when added to the environmental baseline, is likely to jeopardize the ESA-listed species or adversely modify critical habitat. If so, NOAA Fisheries must identify any reasonable and prudent alternatives (RPA) for the action that avoid jeopardy or adverse modification of critical habitat and meet the other regulatory requirements for RPAs. (See CFR §402.02.)

Recovery planning will help identify measures to conserve listed salmonids and increase their survival at each life stage. NOAA Fisheries also intends recovery planning to identify the areas/stocks most critical to species conservation and recovery and to thereby evaluate proposed actions on the basis of their effects on those factors.

This analysis was based on a review and synthesis of the best available scientific and commercial information. Specific sources are listed in the bibliography and cited throughout the body of the document. Primary sources of information included the "Surrender Application for the Bull Run Hydroelectric Project," (PGE 2002a); the "Settlement Agreement Concerning the Removal of the Bull Run Hydroelectric" (PGE 2002b); the "Bull Run Hydroelectric Project Biological Evaluation" (PGE 2002c); the "Environmental Assessment for the Removal of the Bull Run Hydroelectric Project," covering the proposed action (PGE 2002d); and FERC's DEIS (2003).

2. DESCRIPTION OF PROPOSED ACTION

2.1 Action Area

The action area for the proposed decommissioning includes all geographic areas directly or indirectly affected by SA measures and Project operations. This area extends through three sub-drainages in the Sandy River Basin: the Little Sandy River, the Bull Run River, and the Sandy River to its confluence with the Columbia River.

2.2 Proposed Action

It is assumed by NOAA Fisheries that, as noted in section 6.2.2 of the SA, FERC's BA includes the entire action that consultation will occur upon, and therefore FERC will adopt as license conditions all activities identified in the Proposed Action section of the BA.

2.2.1 Continued Operations Prior to an Amended License

Prior to the amended license and dam removal, the existing license conditions will be in effect until Marmot Dam is removed. Under the existing license, PGE currently implements the following measures to protect fishery resources and ESA-listed fish species:

- Provides upstream passage for, and sorting of, adult salmonids via the Marmot fishway.
- Operates downstream juvenile fish bypass facilities at the Marmot Dam diversion canal.
- Maintains minimum instream flow requirements below Marmot Dam.
- Operates to avoid flow fluctuations below Marmot Dam and the Bull Run Powerhouse.
- Operates to avoid spill below Little Sandy Dam.
- Provides hatchery funds in lieu of minimum flows and fish passage at the Little Sandy Dam.
- Operates a tailrace barrier to exclude adult salmonids from entering the Bull Run tailrace pool and encourage fish to move downstream back into the Sandy River.

2.2.2 Interim Operations Under an Amended License

Under the amended license and prior to dam removal, the existing license conditions, which are described above, will be in effect until Marmot Dam is removed. PGE proposes the additional interim measures prior to Project removal (see PGE 2002b, Exhibit A - Decommissioning Plan for more details):

- To protect downstream-migrating juvenile salmonids, beginning in 2005 PGE will limit the diversion canal level to 4.7 ft from February 15 until March 15; from March 15 and continuing for 8 weeks, PGE will operate the diversion canal levels at 4.2 ft for 8 hours daily starting at sunset, and at no more than 4.7 ft all other hours during this 8-week period. To ensure this beneficial measure is implemented during the peak of the fry outmigration, PGE will conduct a minimal monitoring effort to determine fry outmigration timing. Results of this monitoring will determine if modification to the onset of the 8-week period is appropriate.

- PGE will continue to fund the operation and maintenance of the Marmot Dam fish ladder and fish trap until Marmot Dam is removed (PGE 2002b, Decommissioning Plan - Appendix A).

2.2.3 Project Removal Activities

PGE proposes to operate the Project on an interim basis, with additional fish protection measures, until dam removal commences. Subsequently, PGE proposes to surrender the operating license for the Bull Run Hydroelectric Project and decommissioning of the Project. The decommissioning action will consist of the complete removal of both Marmot and Little Sandy Dams, along with the dismantling of their associated water conveyance structures. Fish passage at Marmot Dam will be maintained during dam removal activities. In addition, Roslyn Lake will be drained and the powerhouse and appurtenant structures will be removed unless alternative uses for the powerhouse are found. A long-term monitoring and contingencies plan will be implemented to address impacts to Sandy River habitat and fish passage. PGE is responsible for all these activities, unless otherwise indicated. Descriptions of this proposed action are discussed below by major Project feature. All private Project and non-Project lands, except those associated with Roslyn Lake, will be conveyed to the Western Rivers Conservancy once the Project is surrendered and removed, with the expressed intent that these lands be used to protect and conserve fish and wildlife habitat, public access, and recreation opportunities along the Sandy River. Project water rights will be relinquished, and, as a consequence, these rights will revert to instream use. Overall, this proposed action will result in the cessation of all Project energy generation and water diversions, thus resulting in the Sandy and Little Sandy Rivers reverting back to free-flowing states. The proposed action is described in more detail in PGE's Decommissioning Plan (2002b), which is incorporated herein by reference.

2.2.3.1 Inwater Activities at Two Dams

PGE proposes to remove the two dams using controlled blasting and heavy machinery, including excavators and conventional air hammers. Heavy machinery will be operated in close proximity to the river, and within the river channel. For the decommissioning of Marmot Dam, most construction activities will be performed behind the cofferdam in the dewatered channel. The only inriver work consists of construction of the cofferdam. For the removal of Little Sandy Dam, the construction will occur in the wetted channel during the low flow period, without the use of cofferdams.

PGE will accomplish two fish salvage efforts at Marmot Dam. The first fish salvage effort will occur between the temporary fish weir and Marmot Dam. The second fish salvage effort will occur between the cofferdams.

Prior to draining the area between the cofferdams at Marmot Dam, PGE will attempt to reduce trapping and stranding of salmonids in between the lower cofferdam and the temporary fish ladder (D. Cramer, pers. comm.). The temporary weir will be installed below Marmot Dam several days prior to the closure of the Marmot fish ladder, thus allowing adult salmonids the opportunity to exit the area and continue upstream on their own. Once the fish ladder is closed, adult and juvenile fish will be salvaged by any of the following means: electrofishing, seine nets, or dip nets. Salvage efforts will use appropriate handling and transport techniques to reduce stress and minimize injury to ESA-listed salmonids. Adult fish will be transported upstream of Marmot Dam and released in the Sandy River; juvenile fish will be released in the Sandy River downstream of the temporary fish weir.

Once the two cofferdams are constructed, adult and juvenile salmonids may be trapped in the area between the cofferdams. These fish will be salvaged from this area using techniques identified above. Salvage efforts will use appropriate handling and transport techniques to reduce stress and minimize injury to salvaged salmonids. Adult fish will be transported upstream of Marmot Dam and released in the Sandy River, and juvenile fish will be released in the Sandy River, downstream of the temporary fish weir.

2.2.3.2 Removal of Marmot Dam

PGE proposes to remove Marmot Dam and the associated crib dam, with minimal reservoir sediment removal. PGE's proposal includes complete removal of the roller-compacted concrete (RCC) dam, the older timber crib dam just upstream, the diversion canal, and the fish ladder in one inwater construction season. The only reservoir sediment (sand, gravel, and cobbles) to be removed with this alternative is that which is required for the planned demolition (i.e., that which is in the immediate vicinity of the RCC and timber crib dams). About 20,000 to 30,000 cubic yards (cy) of sediment will be excavated. In order to perform the demolition of the instream structures, a cofferdam will be placed a sufficient distance upstream to permit removal of the old timber crib dam, a portion of which was abandoned in place, and another cofferdam will be constructed downstream of the RCC dam. All Marmot Dam removal activities will then be accomplished “in the dry.”

Upstream migrating fish will be accommodated with a trap-and-haul program throughout the construction period. PGE will install and operate a temporary fish barrier, a denil ladder, and a fish trap, located 600 to 800 ft downstream of Marmot Dam, near the evaluator structure. Migrating fish will travel up the denil ladder near the right bank and into the trap box. The trap box will be lifted onto a truck to transport the fish for release back into the Sandy River.

The upper cofferdam will divert Sandy River flows through the existing diversion canal during construction. The cofferdam will be designed to transmit a maximum discharge of 1,750 cfs with 3 ft of freeboard for dam safety issues, but it is anticipated to divert up to 2,500 cfs around the construction area. Fifty to 60 cfs of Sandy River diverted flow will be used for attraction water at the fish ladder/trap. This attraction flow will be piped from the diversion canal into the trap and cascade down the ladder to the stream. The remainder of the diverted stream flow will spill back to the Sandy River below the downstream cofferdam.

It is anticipated that controlled blasting and excavators will be used to remove the RCC and timber crib dams and fish ladder. The concrete will be rubblized and stockpiled on-site for a beneficial end use, such as road surfacing, structural fill material, or concrete production. The minimal volume of excavated sediment will be stockpiled on U.S. Bureau of Land Management land north of Marmot Dam in a mutually agreeable fashion. The proposed excavation of upstream sediment is intended to be accomplished by employing track-mounted excavators, rubber-tired loaders, and off-highway end dump vehicles. The off-site stockpile will be shaped by a track-mounted dozer. After the dam's fish ladder, minimal sediment, and dam materials and byproducts are removed, the downstream fish barrier and trap and haul will be removed. The cofferdams will be breached during the first natural Sandy River flow event above 2,500 cfs, which will initiate the downstream transport of sediment stored behind Marmot Dam. Once it has been breached, the material making up the cofferdam will be transported downstream with the reservoir sediment.

2.2.3.3 Little Sandy Dam

The Little Sandy diversion dam will be removed during the second low-water season, after Marmot Dam has been removed and flows are no longer being diverted through the canal system to the Little Sandy River. The relatively short height of the dam and historic low stream flows during the dry season are expected to prevent the need for cofferdams for this work. It is anticipated that demolition of the Little Sandy Dam can be accomplished by working from both the upstream and downstream faces simultaneously, with controlled blasting and conventional air hammers and excavating equipment. The concrete will be rubblized and transported off-site for a beneficial end use, such as road surfacing, structural fill material, or concrete production.

2.2.3.4 Removal of All Other Project Features

Canals, Tunnels, Flume, and Ancillary Structures. The concrete canal linings will be ripped, folded into the canal, and covered with fill. The fill will be compacted, sloped to drain, and seeded to control erosion. The fill will be contoured where required to allow existing streams to cross the existing canal alignment, and the stream channel at such crossings will be protected to prevent erosion. The estimated period for the canal demolition is 5 months.

Except for the end of Tunnel No. 1 near the Little Sandy Dam, the tunnels will be closed with concrete plugs anchored into the surrounding rock at or near each opening. Any loose or unstable rock blocks at the portals will be stabilized by scaling or rock bolting. Tunnel No. 1 will have a louvered opening at the end near the Little Sandy Dam to provide access for bats to the potential habitat within the tunnel. A concrete tunnel plug will be installed a suitable distance upstream of the louvered opening. The estimated time for the decommissioning of the tunnels is 7 months.

The time estimated to decommission the wood flume is 13 months. This work will consist of demolition and removal of the wooden flume, wooden columns, foot bridges, and inspection walkways. The removal of the concrete pedestals is not planned, as such demolition may result in more environmental damage than benefits. It is anticipated that this work will be accomplished by cranes operated from within the flume box, with transportation of much of the material provided by the speeder car on the existing rail system. Longer sections may be lifted by helicopter from the site.

Project Powerhouse. The powerhouse, tailrace, transformer building, shop building, office building, fences, pavements, and switchyard will be removed, and the area will be backfilled and seeded. Standard demolition techniques will be employed. This work is expected to be completed within about 10 months. The powerhouse may be reused, if a suitable use can be determined.

Roslyn Lake. The dam, dikes, and outlet structure will be removed over a projected 8-month construction period. The outlet structure will be demolished and disposed of off-site. The portion of the penstocks under Roslyn Lake, under the adjacent roadway, and under the powerhouse will be sealed with concrete. All exposed sections of the penstocks will be removed. The material from the dam and dikes will be spread out over the existing lake area, and graded and seeded to facilitate drainage and minimize erosion.

2.2.4 Disposition of PGE Lands

PGE will donate all of PGE-owned land in the Bull Run area of the Sandy River Basin, with the exception of the lands associated with Roslyn Lake, to the Western Rivers Conservancy. The land totals about 650 acres associated with the Project and 880 acres of non-Project lands. The management goals will be to protect and restore riparian habitat; protect the integrity of the river ecosystem; establish connections between habitat units for terrestrial wildlife; and provide low-impact public access to the rivers and lands.

2.2.5 Transfer of Water Rights

PGE will initiate a process to convert its surface water registration to an Instream Water Right (200 cfs for the Little Sandy River and 600 cfs for Sandy River), which will ultimately be held in trust by the Oregon Water Resources Department for public uses relating to 1) recreation and scenic attraction, 2) protection and maintenance of water quality, and 3) conservation, maintenance, and enhancement of aquatic and fish life, wildlife, and fish and wildlife habitat. The Instream Water Right will be conditioned to maintain up to 40 cfs of existing uses upstream from Marmot Dam, up to 3 cfs of existing uses between Marmot Dam and the confluence of the Sandy River and the Bull Run River, and 16.3 cfs of the City of Sandy's permit on the Sandy River.

2.2.6 Impact Minimization and Monitoring Measures During Dam Removal

2.2.6.1 Project Removal

PGE proposes the following measures to minimize the adverse effects of Project removal (see PGE 2002b, Decommissioning Plan, and the BA for more details):

Revegetation, Noxious Weed Control, and Site Restoration

- Implement a revegetation, noxious weed control, and site restoration plan (PGE 2002b, Decommissioning Plan - Exhibit A).

  See Fish Passage comment below under ESA Impact Minimization Measures.

Endangered Species Aquatic Habitat Impact Minimization Measures

- Remove Marmot Dam during a single season, remove the cofferdam after the inwater construction season using high winter flows, maximize discharge to breach the cofferdam and cause rapid sediment scour, shape reservoir sediment banks to minimize dry season bank sloughing, provide fish passage during inwater dam removal activities, and provide minimum flows downstream in the Sandy River.

Sandy River Fall Chinook Salmon Conservation Program

- Fund ($25,000) a fall chinook salmon conservation program to be implemented by ODFW to minimize adverse impacts to fall chinook salmon (PGE 2002b, Exhibit C, Appendix B).

2.2.6.2 Monitoring

PGE proposes the following monitoring measures (see PGE 2002b, Decommissioning Plan for more details):

Pre-removal Geomorphic Monitoring

- Conduct two geomorphological studies in the Sandy River, one to provide information on baseline conditions, and one to provide a geomorphic context for considering the ecological implications of Marmot Dam removal.

Water Quality

- Monitor turbidity prior to Marmot Dam removal, during structure removal, and after dam removal.

Sediment Monitoring

- Monitor sediment released after removal of Marmot Dam.

Stream Gages

- Fund the maintenance of the existing gage at Little Sandy River and the existing gage on Sandy River near Marmot.

Site Restoration and Monitoring

- Address bank stability in the areas behind Marmot Dam, control erosion in areas that are not behind Marmot Dam or that are in areas considered to be stable, revegetate erodible materials, and monitor presence of noxious weeds in areas disturbed by dam removal activities.

Endangered Species Monitoring and Contingencies Plan

- Implement detailed monitoring and contingency actions to evaluate post-dam fish passage barriers and address any blockages in a rapid and effective manner to minimize incidental take of listed fish species (see Appendix B). The contingency measures will address mechanical removal of passage barriers, creating channel complexity, emergency fish recovery, and lower river trap and haul.

Monitoring Channel Complexity and Fish Passage to Determine Endpoint

- Measure channel complexity as an indicator of potential fish barriers following the removal of Marmot Dam, and determine when post-Marmot Dam conditions in the Sandy River have returned to baseline conditions.

Coordinating Committee

- Form a coordinating committee to oversee implementation of the settlement agreement and decommissioning plan.

Endangered Species Monitoring and Implementation Team

- Convene an MIT to oversee the endangered species fish monitoring and contingencies measures.

Other Basin Monitoring and Research Program

PGE will contribute $100,000 before January 14, 2004, and $200,000 before January 15, 2008, to:

- Develop information that will help guide future recovery or restoration decisions in the Sandy or Little Sandy Rivers.
- Fund research opportunities related to dam removal issues.
- Fund other research opportunities in the Sandy and Little Sandy Rivers.

2.2.7 Proposed Schedule for Decommissioning

PGE proposes the following schedule for decommissioning the Project:

Activity	Schedule
Pre-removal geomorphological and water quality monitoring	August 2002 - August 2006
Permitting	November 2002 - March 2007
Removal of Marmot Dam	July 2007 - October 2007
Removal of Little Sandy Dam	July 2008 - October 2008
Removal of canals	November 2007 - July 2008
Removal of tunnels	November 2007 - September 2008
Removal of flume	July 2008 - June 2009
Demolition of Project powerhouse	August 2008 - June 2009
Removal of Roslyn Lake	July 2008 - November 2008
Post-removal monitoring and contingency response	October 2007 -

2.3 Interrelated and Interdependent Effects

Effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. In this consultation process no such activities were determined, and therefore no further analysis was needed.

3. SPECIES INCLUDED IN THE CONSULTATION

Federally Listed, Proposed, and Candidate Anadromous Salmonids Occurring in the Action Area

Project facilities and operations in the Sandy River Basin potentially affect three ESUs of anadromous salmonids that are listed or candidates for listing under the ESA (Table 3-1). These listed or candidate salmonid ESUs that occur in the basin are LCR chinook salmon (threatened), LCR steelhead (threatened), and LCR/Southwest Washington coho salmon (candidate). Consultation is only required for listed and proposed species; therefore, the candidate species will not be addressed further in this Opinion. Coastal cutthroat trout also occur in the basin. This species is currently under the jurisdiction of the U.S. Fish and Wildlife Service and will not be addressed in this Opinion.

Section 7 of the ESA requires that Federal agencies consult with NOAA Fisheries or USFWS when a proposed action may affect Federally listed species. NOAA Fisheries has jurisdiction over anadromous fish species, while the USFWS has jurisdiction over all terrestrial and freshwater biota.

Salmonid populations, their listing status, and descriptions of the ESUs are shown in Table 3-1. The listed salmonid populations are chinook salmon (including both spring- and fall-runs), and winter steelhead (hatchery summer steelhead are excluded). Coho salmon are listed as a candidate species.

Lower Columbia River Chinook Salmon ESU

This ESU encompasses chinook salmon runs in tributaries between the White Salmon and Hood Rivers and the mouth of the Columbia River. NOAA Fisheries' Willamette/Lower Columbia Technical Recovery Team (TRT) has tentatively identified 30 populations within this ESU (Myers et al. 2003). Two of these populations occur within the action area: Sandy River early fall-run chinook salmon (which includes late fall-run salmon as a possible sub-population) and Sandy River spring-run chinook salmon. The Sandy River spring-run chinook salmon population is considered extirpated and fish returning in the spring are hatchery stock. Abundance trends for populations within the LCR chinook salmon ESU, including the Sandy River late fall-run population, have been reviewed in a draft report by NOAA Fisheries' West Coast Salmon Biological Review Team (BRT 2003). Trends of the late fall-run population have generally been declining over long and short time periods. Some of the abundance information included in that draft report has been updated (http://www.nwfsc.noaa.gov/trt/brtrpt.htm) and indicates increased abundance in 2000 and 2001. Between 1990 and 2001, the early run fall chinook salmon "sub-population" in the Sandy River ranged from 88 to 420, and the late run components of the fall chinook population ranged from 88 to 2,033.

Lower Columbia River Steelhead ESU

This ESU encompasses steelhead runs in tributaries between the White Salmon and Hood Rivers and the mouth of the Columbia River. NOAA Fisheries' Willamette/Lower Columbia TRT has tentatively identified 23 populations within this ESU (Myers et al. 2003). One of these populations occurs within the action area: Sandy River winter-run steelhead. Abundance trends for populations within the ESU, including the Sandy River winter-run population, have been reviewed in a draft report by NOAA Fisheries' West Coast Salmon Biological Review Team (BRT 2003). Trends of this population have generally been declining over long time periods. The draft report did not include short-term trends. Some of the abundance information included in that draft report has been updated (http://www.nwfsc.noaa.gov/trt/brtrpt.htm) and indicates continued low abundance, compared to abundance in the mid-1990s, 2000, and 2001. Abundance ranged from 784-3,065 spawners between 1990 and 2001.

FERC concluded, based on the analysis in the BE (PGE 2002c), that the proposed action is likely to adversely affect the following listed or candidate salmonid ESUs:

- LCR chinook salmon ESU (threatened)
- LCR steelhead ESU (threatened)
- LCR/Southwest Washington coho salmon ESU (candidate)

Table 3-1. Special status salmonids in the Sandy River Basin.

SPECIES	ESU	FEDERAL STATUS	NOTES
Chinook Salmon	Lower Columbia River	Threatened 64 Fed. Reg 143086, March 24, 1999 65 Fed. Reg 42422, July 10, 2000	***Description of ESU:*** ESU includes all naturally spawned fall- and spring-run chinook salmon from mouth of Columbia River to crest of Cascade Range (including tributaries), excluding areas above Willamette Falls. Includes spring-run, tule, and late-fall "bright" populations. Progeny of naturally spawning hatchery fish are treated as listed for the purposes of the ESA. ***Affected Runs in the Sandy River Basin:*** Listing includes both fall- and spring-run chinook salmon in the Sandy River Basin, despite introductions of spring-run fish from the Upper Willamette River ESU. Listing excludes Sandy River spring-run hatchery stock, which was determined not to be essential for recovery.
Steelhead	Lower Columbia River	Threatened 63 Fed. Reg 13347, March 19, 1998 65 Fed. Reg 42422, July 10, 2000	***Description of ESU:*** ESU includes all naturally spawned winter- and summer-run steelhead in the Columbia River Basin and tributaries between Cowlitz and Wind Rivers in Washington and Willamette and Hood Rivers in Oregon, excluding upper Willamette River Basin above Willamette Falls. Hatchery stocks were included in the ESU, but no hatchery populations were determined essential for recovery and they are, therefore, not covered under the listing. ***Affected Runs in the Sandy River Basin:*** Listing includes later-returning native winter steelhead in the Sandy River Basin. Listing excludes early-run hatchery winter steelhead stock in the Sandy River Basin. Listing excludes Skamania-origin summer-run steelhead in the Sandy River Basin.
Coho Salmon	Lower Columbia River/ Southwestern Washington	Candidate Species 60 Fed. Reg 38011, July 25, 1995	***Description of ESU:*** ESU includes all naturally spawning populations from all tributaries of the Columbia River below approximately the Klickitat and Deschutes Rivers, as well as coastal drainages in southwest Washington. ***Affected Populations in the Sandy River Basin:*** Listing of this ESU will likely include on later returning native coho salmon in the Sandy River Basin.

4. ENVIRONMENTAL BASELINE AND STATUS OF THE SPECIES

The "environmental baseline" is defined in the ESA Section 7 implementing regulations as:

> "the past and present impacts of all Federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process" (50 CFR §402.02).

The Consultation Handbook (USFWS and NOAA Fisheries 1998) further states that the environmental baseline is:

> "an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem within the action area. The environmental baseline is a 'snapshot' of a species' health at a specified point in time."

These definitions illustrate that the environmental baseline is more than the current condition of physical habitat within the action area. The environmental baseline is the progression of the physical, chemical, and biological conditions within the action area over time that has resulted in the current status of the listed species. The environmental baseline has been described in great detail throughout the package accompanying the SA and that information is herein incorporated by reference and summarized below.

Action-area biological requirements are those factors, appropriate to the scale of the action area, that support and are necessary for attainment of the rangewide biological requirements of a population (adequate reproduction, numbers, and distribution). If the action area is sufficiently large, there is no distinction between the rangewide and action-area biological requirements of a population. However, biological requirements for action areas that encompass a limited portion of the population's range may be expressed in terms such as: 1) adequate survival rates through particular life history stages, and 2) habitat characteristics that are expected to result in adequate survival and distribution of individuals within a population.

This consultation defines action-area biological requirements in terms of habitat requirements. As described in NOAA Fisheries (1999, Habitat Approach), there is a strong causal link between habitat modification and the response of salmonid populations. Those links are often difficult to quantify. In many cases, NOAA Fisheries must describe biological requirements in terms of habitat conditions in order to infer the populations' responses to the effects of the action. To survive and recover, a wide-ranging salmonid ESU must have adequate habitat available to support life stage-specific survival rates. Properly functioning habitat conditions (PFC) will support adequate survival and distribution of salmon and steelhead throughout their ranges and life history stages. NOAA Fisheries typically considers the status of habitat variables in a matrix of pathways and indicators (NOAA Fisheries 1996), which was developed to describe PFC in forested montane watersheds. In this consultation, a more generalized evaluation of habitat characteristics that is relevant to the action area is employed in Sections 5 and 6.

4.1 Sandy River - Geomorphic Setting

The Sandy River is characterized by naturally high sediment loading as a result of past laharic events, Mount Hood glaciers, and lithology. The Sandy River exhibits many characteristics typical of alluvial rivers. Moving from upstream to downstream reaches, gradient and channel-bed particle size typically decrease, and alluvial storage increases as the channel becomes wider and less steep.

For the purposes of geomorphic analysis, the Sandy River from Marmot Dam downstream to the Columbia River was delineated into five reaches, with the reach immediately upstream of the dam representing a sixth reach of concern. The following sections summarize a description of current geomorphic conditions in each of these reaches, including geomorphic characteristics and salmonid habitat characteristics. The geomorphic characteristics of each of these reaches are also described in table 5-7 of the BA.

4.1.1 Reach 0: Upstream of Marmot Dam/Reservoir-influenced reach

The impoundment formed by Marmot Dam has filled to near the dam's crest with sediment and now functions as an alluvial river reach. Compared to upstream and downstream reaches, the reach immediately upstream of Marmot Dam has a lower gradient. These differences are a result of the grade control provided by the dam and the backwater effect of the dam's impoundment. The Sandy River upstream of Marmot Dam is affected by the backwater effect of the dam for a distance of about 1.6 to 2 mi (1-3.2 km) (Stillwater Sciences 2000a). The reservoir-influenced reach has pool-riffle/plane-bed morphology, with a higher frequency of pools than upstream and downstream reaches (Cramer et al. 1998). Substrates in the reservoir-influenced reach consist of cobbles, small boulders, and gravel, and the sand content in the subsurface (i.e., in the sediment that has accumulated in the reservoir) is high.

About 980,000 cy (744,800 cubic meters [cm]) of sediment are stored behind Marmot Dam (Squier Associates 2000). The grain size distribution of this sediment has an important influence on its downstream transport patterns and associated impacts. The reservoir sediment consists of two main units (layers), with the pre-dam channel bed representing a third distinct unit (Squier Associates 2000). The uppermost layer is composed of sandy gravel with cobbles and boulders, becoming thicker toward the dam. The next layer is predominantly fine sediment (silty-sand to sand with gravel). The pre-dam channel bed lies below the second layer, and consists primarily of coarse sediment.

The pool-riffle morphology that characterizes the reservoir-influenced reach provides habitat that is suitable for salmonid spawning, rearing, and holding. Gravel suitable for spawning is relatively abundant in this reach compared to reaches immediately upstream and downstream, likely due to the grade control and backwater effect created by Marmot Dam. Most of the fall chinook salmon that pass over Marmot Dam likely spawn in this reach (Cramer et al. 1998). Spring chinook also spawn in this reach. Deep pools (< 10 ft [3.05 m]) are present in this reach and provide habitat suitable for adult holding and summer rearing habitat for chinook salmon, coho salmon, and steelhead.

4.1.2 Reach 1: Marmot Dam to the Upstream End of the Gorge

This reach is 1.5 mi (2.4 km) long and is bounded by a high terrace on the left bank that is actively eroding in places. Reach 1 is characterized by a 0.01 gradient, moderate confinement at bankfull flow, and moderately pronounced forced pool-riffle morphology, with a few small lateral cobble/boulder bars. The bed surface consists mainly of cobbles and boulders; gravels are limited. Sand content in the bed subsurface is generally very low.

Reach 1 contains two main depositional areas: 1) a large alder-vegetated bar and side channel known as Beaver Island (river mile [RM] 29.4-29.2), and 2) a large alcove/backwater pool at the downstream end of the reach (RM 28.7). The alder bar/side channel (Beaver Island) is located 0.6 mi (0.96 km) downstream of Marmot Dam and has a large woody debris (LWD) jam at its head. The alcove/backwater pool (RM 28.7) is forced by constriction of the channel and a bedrock wall at the head of the gorge, and may be a valuable salmonid rearing and holding site. Stillwater Sciences (2000a) estimated the amount of active sediment storage in Reach 1 downstream of Marmot Dam as about 180,000 cy (136,800 cm); on a linear basis, this corresponds to about 120,000 cy/mi (57,000 cm/km).

Small amounts of gravel in patches suitable for spawning are present in Reach 1, and spring chinook salmon spawning has been observed in this reach. However, the channel bed in Reach 1 is dominated by boulder and cobble bed substrates, with relatively few depositional areas of gravel suitable for salmonid spawning. The reach does provide suitable rearing habitat for several salmonid species; the side channels and backwaters at the alder-vegetated bar described above, and the deep pools, and coarse substrates with interstitial spaces provide suitable habitat for chinook salmon and steelhead winter rearing. Deep pools present in this reach also provide adult holding habitat for spring chinook salmon and summer steelhead.

4.1.3 Reach 2: Sandy River Gorge

The gorge reach is 4 mi (6.4 km) in length and is bounded by 65 to100-ft (19.83-30.50-m) high bedrock strath terraces, with steep hillslopes above. Reach 2 is characterized by a 0.01 gradient, high confinement, and step-pool morphology, with only patchy cobble/boulder deposits and long, deep bedrock pools that are separated by coarse-bedded riffles and boulder rapids. Large (house-sized) boulders are present in the channel, likely originating from the canyon walls. These boulders form momentum defects, but often deposition behind them is limited. In general, few deposition areas are present in this reach. Bedrock exposure is more common in the channel bed in this reach than in other reaches of the Sandy River, and the bed is highly armored. Sand content in the bed subsurface is generally very low. The steep gradient and high confinement in this reach create very high shear stresses, resulting in high sediment transport capacity. Active sediment storage in this reach is estimated to be about 410,000 cy (311,600 cm) (linear=100,000 cy/mi [47,500 cm/km]), much of which is located in the moderately confined section at RM 28.5-27.6 (Stillwater Sciences 2000a). In the rest of the gorge, channel sediment storage is low.

The deep bedrock scour pools in the gorge are the primary salmonid habitat within the gorge, in particular providing suitable habitat for adult holding during upstream migration. Pools may also be used for juvenile rearing, especially by chinook and coho salmon during the summer, although coho salmon prefer habitats associated with LWD and few such habitats are present in the gorge. Riffles with coarse bed material also may provide rearing habitat for steelhead. Because shear stresses are extremely high in the gorge during high flows, and refuge habitats (e.g., side channel, vegetated floodplain) are nearly absent, winter rearing is likely limited in this reach. In addition, little or no spawning habitat is present in this reach because of high sediment transport capacity and limited availability of depositional areas.

4.1.4 Reach 3: Downstream End of Gorge to Dodge Park

Reach 3, which extends from the downstream end of the gorge (near Revenue Bridge) to the Bull Run River confluence at Dodge Park, is about 6 mi in length. This reach widens considerably compared to Reaches 1 and 2 (with an average width of 160 ft), has an average gradient of 0.006 (compared to 0.01 in Reaches 1 and 2), and is characterized by forced pool-riffle morphology, with many cobble/boulder bars and a cobble/gravel-dominated channel bed. Because the channel and valley bottom widen and gradient decreases downstream of the gorge, sediment transport capacity is lower than in the gorge, and potential for sediment deposition increases. Several wide areas with mid-channel bars are present, both upstream and downstream of Revenue Bridge (RM 24.5), and some side-channel features are also present. Shear stresses remain relatively high, however, and although average bed particle sizes in this reach decrease compared to Reaches 1 and 2, gravel suitable as spawning substrate is limited, occurring only in scattered patches and pool tail-outs (ODFW 1990, 1997a). The sand content in the bed subsurface is generally high compared to upstream reaches, but low compared to downstream reaches. River banks are mostly mudstone bedrock, debris fans, and cutbanks of vegetated alluvial features. Active alluvial storage is estimated to be about 1,300,000 cy (988,000 cm) (linear=220,000 cy/mi [104,500 cm/km]) (Stillwater Sciences 2000a). This is substantially higher than Reaches 1 and 2, reflecting the wider active channel and increased depositional potential in Reach 3.

This reach provides suitable habitat for fall chinook salmon and steelhead (spawning, summer rearing, winter rearing) and coho salmon (summer and winter rearing), and provides a migration corridor for anadromous salmonids that spawn and rear upstream of Marmot Dam. Spawning habitat for chinook salmon and steelhead is available in isolated locations. Spawning habitat suitable for chinook salmon was observed upstream of Revenue Bridge near the downstream end of the gorge (RM 24.4) (Stillwater Sciences 2000a). PGE (1998a) surveys documented winter steelhead redds downstream of Revenue Bridge and near the confluence of Cedar Creek in 1998; many of these redds were located in side channels. Summer rearing habitat is available for chinook and coho salmon in the low-velocity pool and glide habitats, and steelhead summer rearing habitat is abundant in pool, riffle, and glide habitats. Substrate used by chinook salmon and steelhead during winter rearing is abundant. Winter refuge habitat is available in side channel, overflow channel, and vegetated floodplain habitats.

4.1.5 Reach 4: Dodge Park to Dabney Park

Reach 4 extends from the Bull Run confluence (Dodge Park) to Dabney State Park, a length of 12.5 mi (20 km). This reach has an average gradient of about 0.0025, is bounded by high (mostly alluvial) terraces, and is characterized by pool-riffle morphology, with many cobble/gravel bars. The channel bed is a mixture of cobbles, gravel, and sand. Sand content in the bed subsurface is generally high, notably increasing at Oxbow Park. River banks generally consist of mudflow deposits (which include unconsolidated silt, sand, and conglomerate deposits), vegetated alluvial bars, and competent bedrock originating from Mount Hood volcanic material. Banks formed of mudflow deposits are 23 to 30 ft (7-9.2 m) high along some reaches and may be an important source of fine sediment to the channel.

In Reach 4, channel confinement, gradient, and bed particle size decrease further compared to reaches upstream, with these tendencies particularly evident in the reach from Oxbow Park (RM 11.9) to Dabney Park (RM 6.6). Large bars, side channels, overflow channels, and island features are present in larger magnitude and greater frequency. The percentage of the active bed and bars covered with sand increases, and in portions of Reach 4 (particularly downstream of Oxbow Park), the active bed is saturated with sand, and the potential for additional sand storage in the interstices of coarser sediment is low. Many of the active channel bars are mantled with overbank sand deposits and have side channels. Reach 4 has a large amount of coarse and fine sediment stored in the active and semi-active channels. The volume of sediment stored in active storage sites is an estimated 4,400,000 cy (334,4000 cm) (linear=350,000 cy/mi [166,250 cm/km]) (Stillwater Sciences 2000a).

This reach provides suitable habitat for steelhead and chinook and coho salmon; in particular, it provides substantial spawning habitat for fall chinook salmon and winter steelhead. The majority of fall chinook salmon spawning habitat in the Sandy River and the majority of mainstem spawning habitat used by winter steelhead occur in Reach 4 (PGE 1998a), reflecting the increased availability of spawning-sized gravel in this reach. Most of this spawning habitat is located downstream of Oxbow Park (PGE 1998a). Chinook salmon and steelhead spawning has also been observed in tributaries to the Sandy River within this reach, specifically Buck, Gordon, and Trout Creeks (ODFW 1997a). Summer rearing habitat is available for chinook and coho salmon in low-velocity pools and glides, and steelhead summer rearing habitat is abundant in pool, riffle, and glide habitats. Coarse substrates potentially used by chinook salmon and steelhead during winter rearing are abundant. Winter refuge habitat is available in side channel, overflow channel, and vegetated floodplain habitats. Side channels in this reach likely provide important spawning and summer and winter rearing habitat for salmonids; these types of habitats are particularly suitable for juvenile coho salmon rearing.

4.1.6 Reach 5: Dabney Park to Mouth of the Sandy River

Reach 5 is 6 mi (9.6 km) long and is characterized by a 0.0007 gradient (compared to 0.0025 in Reach 4), moderate-to-low confinement at bankfull flow, and dune-ripple morphology with large gravel/sand alternate and medial bars. Many of the active channel bars, some spanning 50% of the channel area, are mantled with overbank sand deposits that have created side channels. The channel bed is a mixture of sand and gravel, is highly mobile, and has a very high sand content in the bed subsurface (Stillwater Sciences 2000a). The decrease in bed particle size is a function of decreased channel gradient and confinement. Active sediment storage, estimated at about 2,200,000 cy (1,672,000 cm) (linear=370,000 cy/mi [175,750 cm/km]), is the highest per unit length of any reach in the Sandy River (Stillwater Sciences 2000a). This reflects the increased channel width and the decreased sediment transport capacity in this reach compared to upstream reaches.

This reach contains spawning and rearing habitat in its upstream end, particularly for fall chinook salmon and winter steelhead, and serves as a migration corridor for all fish entering the Sandy River system. The majority of spawning habitat for fall chinook salmon occurs upstream of Lewis and Clark State Park, although overall this reach supports less fall chinook salmon spawning than Reach 4. Steelhead spawning habitat is also present in isolated locations; however, steelhead tend to spawn in smaller channels upstream. The upper portion of this reach provides abundant summer rearing habitat for chinook and coho salmon and steelhead. Winter refuge habitat for all salmonids is also available in side channel, overflow channel, and vegetated floodplain habitats. In addition, coarse substrate suitable for winter rearing of chinook salmon and steelhead is limited.

The Sandy River delta forms the downstream-most portion of Reach 5. In the delta, the channel is sand-bedded and depositional dynamics are strongly influenced by the backwater effect of the Columbia River. The Sandy River delta is not likely used for extended periods by any salmonid species or lifestage; this area primarily serves as a migration route.

4.2 Little Sandy River - Geomorphic Setting

The lower Little Sandy River (below the diversion dam) consists of two distinct geomorphic reaches; the reach immediately upstream of the dam will also experience morphologic changes following dam removal. The average channel gradient is 0.028, the average active channel width is 47 ft (14 m), and about two-thirds of total reach length consists of riffles, cascades, or rapids (the rest consists of pools) (ODFW 1997b). The substrate is composed of boulders, cobbles, and bedrock with few gravels. Previous surveys (Craig and Suomela 1940; ODFW 1997b; Hardin 1998a; Stillwater Sciences 2000a) have noted that spawning substrate is severely limited (or nonexistent) downstream of Little Sandy Dam. The lower Little Sandy River (below the upper end of the reservoir deposit) consists of two distinct geomorphic reaches.

4.2.1 Upstream of Little Sandy Dam

The sediment accumulation behind Little Sandy Dam extends upstream for a distance of about 300 ft (91 m) and has an average depth of about 4 ft (1 m) (maximum depth is about 8 ft [2 m]). Further upstream of Little Sandy Dam, the channel is no longer bedrock constrained, causing a change in morphology and increased frequency of gravels, although boulders and cobbles are dominant substrates (ODFW 1997b).

4.2.2 Little Sandy Reach 1

The reach from Little Sandy Dam to about 0.3 mi (0.5 km) downstream of the dam is a geomorphically distinct reach. This reach has a step-pool/plane bed morphology, an average gradient of 0.02, and channel bed substrates consisting of cobbles (50% by volume) and gravel (40% by volume) within an immobile framework of boulders (10% by volume). Although gravel is present in the channel bed, mixed in with cobbles, no gravel patches that are suitable for spawning were observed in Reach 1. Reach 1 has a relatively wide valley constrained by bedrock, with high strath terraces within the valley walls constraining the channel on the left bank. The active channel has an average width of about 33 ft (10m), which appears to be less than under unregulated conditions, due to encroachment of riparian vegetation onto channel bars. Boulder/cobble bars are densely vegetated with willows and alders. Removal of LWD that accumulates at Little Sandy Dam by PGE maintenance crews has likely contributed to the low frequency of LWD in Reach 1. Evidence of bank erosion along this reach is provided by exposure of tree roots of Western red cedars growing on 3 to 5 ft (0.9-1.5 m) terrace banks, perhaps as a result of aggradation caused by reduced sediment transport capacity.

Pools suitable for steelhead resting during migration are spaced at regular intervals throughout Reach 1 (pool frequency in this reach is 4.3 channel widths/pool). Deep pools (> 10 ft [3 m]) suitable for extended holding, however, are not present. Reach 1 does not currently contain spawning habitat, although increased flows could make some channel-margin areas suitable for steelhead spawning. Reach 1 contains habitat that could be used for summer and winter rearing by juvenile steelhead, although under current conditions summer rearing habitat is limited by low summer instream flows. Interstices within coarse substrate particles, which provide suitable winter rearing habitat for juvenile steelhead (Everest and Chapman 1972), are abundant in Reach 1.

4.2.3 Little Sandy Reach 2

Reach 2 extends from about 0.3 mi (0.5 km) below Little Sandy Dam downstream to the confluence of the Little Sandy with the Bull Run River (1.7 mi below the dam). This reach has an average slope of about 0.028 and is constrained within a narrow bedrock gorge. The channel is characterized by step-pool morphology, with boulder-dominated riffles/rapids separating pools and cobble bars that have a surface elevation about 5 ft (1.5 m) above the current active channel bed. Most of the channel bed is mantled by coarse alluvium, although bedrock protrusions are common, localized bedrock nick points are present, and some pools lack an alluvial mantle. Gravel deposits are limited in Reach 2, reflecting the high sediment transport capacity in the reach, and mostly occur as patches formed on channel margins, in pool tails, and in association with momentum defects (e.g., boulders, bank irregularities). Although the bed is dominated by coarse sediment, sand deposits were also observed in the channel bed and on low cobble bar surfaces, which were inundated by the November 1999 flood. Valley width averages 82 ft (25 m) (ranging from 52-130 ft [16-40 m]), active channel width averages 66 ft (20 m) (ranging from 30-72 ft [9-22 m]), and bankfull depth averages about 2.6 ft (0.8 m). In addition to sediment supply from upstream and tributary sources, sediment is supplied to this reach by recruitment of boulders from rhododendron formation cliffs and banks, which are highly erosive in some locations, and Quaternary alluvial terraces that overlie the rhododendron bedrock along portions of the reach that contribute cobbles to the channel. There are six small debris jams in this reach, and only two logs that span the channel. The upstream end of Reach 2 (from about 0.3 to 0.6 mi [0.5-1 km] below the dam) represents a transition between Reaches 1 and 2, having a lower gradient (about 0.025) than the majority of Reach 2 with small gravel deposits behind boulders. Further downstream, the Little Sandy River steepens and becomes more confined. Several bedrock nick points, which are about 100 to 500 ft (30.5-152 m) in length and 6.6 to 13-ft (2-4 m) high, create substantial elevation change in the channel bed. The main fish habitat within this reach is provided by two large pools and one riffle (0.9 to 1.0 mi [1.4-1.6 km] below the dam). These pools are about 100 ft (30.5 m) in length, have a maximum depth of 6.6 to 10 ft (2-3 m), and are constricted within bedrock walls.

4.3 Turbidity in the Sandy River Basin

Water quality standards applicable to the Sandy River Basin are found in Oregon Administrative Rules (OAR) 340-41-0485. Historically, the Sandy River exhibits higher turbidity levels than many streams in the region due to the influence of glacial runoff. Especially during the summer months, glacial melt water can contribute significantly to the suspended sediment load of the Sandy River. These elevated turbidity levels do not, however, exceed OAR water quality standards, as they reflect natural conditions. OAR standards indicate that "no more than a ten percent cumulative increase in natural stream turbidities shall be allowed…." (OAR 340-41-0485). The diversion of Sandy River water at the Marmot Dam and into the Bull Run River may introduce higher than normal levels of turbidity from the Bull Run Powerhouse to the mouth of the Bull Run than under existing conditions.

As part of the Environmental Assessment (PGE and FERC 2000), turbidity levels were measured over a 72-hour period in mid-May and again in mid-August (PGE 2002c, table 5-6). Across the 15 sites sampled, mean turbidity levels ranged from 0.5 NTU to 1.6 NTU in May, and 0.4 NTU to 17.5 NTU in August. In general, levels measured in August were significantly higher than those measured in May. This trend did not hold true at all sites, however, and may reflect the influence of summertime glacial melt water contributing to the turbidity of Sandy River, and to those sites influenced by water diverted from the Sandy River.

Overall, turbidity is occasionally high in the Sandy River (PGE 2002c, section 5.2.2). Listed salmonids may encounter elevated levels of turbidity either as adults or as juveniles, although the potential effects of elevated turbidity has not been quantified. Turbidity in the Project area is caused by natural sources of sediment, and is not likely to be increased by the Project. However, sampling results (PGE 2002c, section 5.2.2.1.) indicate that the water diverted from the Sandy River to the Little Sandy River resulted in a thirteen-fold increase in turbidity levels.

4.4 Habitat Access and Physical Barriers

One must highlight the present and future operation of the Bull Run Project is not part of the environmental baseline. However, the effects of past operations of the Project have contributed to the current status of the species and those continuing effects of past operations are relevant to the baseline.

NOAA Fisheries has identified habitat access as an important component of the PFC pathway. Among the indicators of PFC is the presence or absence of physical barriers. Migration corridors are also identified as an essential habitat type, and safe passage conditions are identified as an essential feature of critical habitat (NOAA Fisheries 2000a). Existing information on baseline habitat access conditions and the effects of existing Project operations on habitat access are summarized below.

Maintenance of naturally reproducing populations of anadromous salmonids upstream of dams requires facilities for effective upstream passage of adult fish. Access to historically available spawning and rearing habitat may be affected by the design of fish passage facilities and species-specific propensities to use fish passage structures. Delays in migration may also result from attraction of fish to cooler water or higher flows at powerhouse discharges.

4.4.1 Upstream Passage and Potential Delays for Adult Salmonids

Upstream passage at Marmot Dam is provided by an existing fish ladder. Hatchery fish are sorted out using a temporary trap that was installed within the ladder. Only unmarked fish are allowed access to the upper Sandy River watershed. No evaluation of the performance of this fish ladder has been conducted. Passage delay may result from trap operations, or from closure of the ladder due to sediment deposition during high flows.

Upstream passage is not provided for at the Little Sandy Dam. About 6.5 mi of anadromous fish habitat is currently blocked. PGE operates to avoid spill at the Little Sandy Dam in order to prevent attracting salmonids into the Little Sandy River, where they may become stranded when spill is stopped.

The Bull Run Powerhouse does not block upstream fish passage. However, adult salmonids may be falsely attracted to the discharge from the powerhouse, as a portion (at times, a substantial portion) of this water originates from the Sandy River. False attraction may reduce spawning success due to delay or exposure to poor habitat conditions.

In 1996, PGE added a tailrace barrier to the weir below the Bull Run Powerhouse to exclude adult salmon from entering the tailrace pool and to encourage fish to move downstream back into the Sandy River (PGE 1996). The barrier is typically erected in April and removed near the end of October (PGE 1998b). The number of adult fish arriving at the powerhouse has not been documented.

4.4.2 Downstream Passage

Juvenile anadromous salmonids produced upstream of hydroelectric facilities may be required to negotiate diversion canals, turbines, spillways, or other obstructions in order to complete their life cycles. Juveniles entrained into flow diversions may experience direct or indirect mortality. Passage of salmonid juveniles through turbines can also reduce survival of downstream-migrating fish. Facilities designed to provide juvenile passage around dams can be used to reduce juvenile mortality associated with reservoir and diversion projects.

4.4.2.1 Downstream Passage at Marmot Dam

Juvenile salmonids produced upstream of Marmot Dam can migrate downstream by three pathways: 1) passing over the dam via the spillway, 2) entering the Marmot diversion canal and being redirected to the Sandy River via a juvenile bypass facility, or 3) being entrained into the Marmot diversion canal and transported to the Little Sandy River or Roslyn Lake. From Roslyn Lake, fish can return to the river only via the Bull Run Powerhouse turbines.

Currently, downstream migrants that enter the canal are screened out and enter a bypass system that returns juveniles to the Sandy River downstream of Marmot Dam. The bypass facility uses rotating screens (Cramer 1993). Since its initial installation, several major improvements have been made to the Marmot Dam juvenile bypass facility. Also, in 1998, a new surface collector system for fry was added in an effort to improve passage of fry.

As required by its FERC license, PGE has evaluated the performance of the juvenile bypass facility (Cramer 1993; Ward and Friesen 1998). The study identified few impacts to fish larger than 2 inches (50 mm) fork length. For these larger fish, trap efficiency was high. Estimated survival for fish entering the canal was 95% for hatchery spring chinook salmon and 97.3% for hatchery steelhead (Cramer 1993). However, salmonid fry experienced low bypass efficiencies and high mortality rates. Efficiency was related to the elevation of the water surface in the canal, with the percentage of fry using the bypass decreasing as water surface elevation (and depth to the bypass ports) increased. The percentage of fry using the bypass exceeded 94.6% for water surface elevations ranging from 2.75 to 3.81 ft (0.8-1.2 m), but was much lower (averaging 49.4%) for water surface elevations exceeding 5 ft (1.5 m).

In 1998, PGE evaluated the effectiveness of the surface collector ports added to the juvenile bypass system that year to improve passage of fry. The objective of the 1998 study was to evaluate the effectiveness of the new ports at higher flows than had been previously allowed by FERC. The total mortality rate (not corrected for handling mortality) for wild salmonid fry averaged 27.5%. The total mortality rate (corrected for handling mortality) for marked hatchery chinook salmon fry averaged 35.2% (Ward and Friesen 1998).

4.4.2.2 Downstream Passage at Little Sandy Dam

The Little Sandy Dam is not equipped with either juvenile downstream passage facilities or screens. Because the dam is a barrier to upstream anadromous fish passage, no chinook or coho salmon are produced upstream of the dam. Resident coastal cutthroat and rainbow trout populations, however, occur upstream of the dam. The Little Sandy Dam prevents dispersal of adults and juveniles from these populations downstream to the Little Sandy and Bull Run Rivers. Fish that enter the diversion canal at Little Sandy Dam are diverted into Roslyn Lake. The only route of passage out of the Roslyn Lake is through the Bull Run Powerhouse turbines.

4.5 Water Temperature

Historic water quality monitoring data indicate that, with the exception of temperature, water quality falls within the limits of the standards set out in the OAR (PGE 1998b). The Oregon Department of Environmental Quality (ODEQ) has listed two stream segments in the Sandy River Basin as water quality limited, and has included them in the 1998 Draft 303(d) List (ODEQ 1998). The Bull Run River exceeded the temperature standard applied to waters designated as salmonid rearing from its mouth to the City of Portland's Bull Run Reservoir No. 2. The Sandy River exceeded the temperature standard for salmonid rearing from its mouth up to Marmot Dam.

Although historic conditions indicate that water temperature in the Sandy River Basin is problematic, and natural levels of turbidity within the Sandy River are high, overall, the U.S. Forest Service (USFS 1993) has defined water quality in the basin as "outstandingly remarkable" and several segments of the Sandy River and its tributaries have been designated as "Wild and Scenic Rivers."

Flow in the lower Bull Run River and lower Sandy River is regulated by PGE powerhouse operations at the Bull Run Hydroelectric Project. With a maximum generation capacity of 900 cfs, operation of the Bull Run Powerhouse substantially increases flows in the lower Bull Run River. The Sandy River Basin experiences flow diversions from both the Little Sandy and Sandy Rivers. Flows are diverted into Roslyn Lake and discharged into the Bull Run River at the powerhouse. Flow diversion can be expected to increase water temperature in the downstream reaches experiencing reduced flow. Impoundment of water may result in warming, while hypolimnetic releases may contribute cooler than normal water when released to streams. Powerhouse discharges may increase or decrease downstream water temperature.

In order to assess present water quality conditions, samples were collected in 1999 during the months of May and August, according to the Oregon Plan for Salmon and Watersheds Water Quality Monitoring Guide Book and protocols in EPA 40 CFR 136. The May sampling was chosen to reflect snowmelt conditions, while the August sampling was chosen to reflect low flow, high temperature conditions. Sampling sites were selected on the Sandy, Little Sandy and Bull Run Rivers, and were situated in the vicinity of the Project. Additional sites were within Roslyn Lake and in the flume just prior to entering Roslyn Lake, for a total of 16 sites.

A seven-day moving mean of daily maximum (SDMMDM) temperature was calculated for water temperatures collected every 30 minutes from late June through early October, 1999, at a total of 9 sites in the Sandy River Basin. The SDMMDM smoothes out some of the fluctuations in the temperature profile and provides a picture of the average temperature affecting fish over a longer period of time. The SDMMDM is the basis of the ODEQ water quality standard for stream temperature. Of the 9 sites sampled, all, with the exception of the 2 upstream sites (SR01 and SR02) on the Sandy River, exceeded the ODEQ stream temperature standard for salmonid rearing of 64°F at some point during the sampling period.[1]

Daily fluctuations (difference between daily maximum and daily minimum temperatures at a site) in water temperature were calculated and are summarized in Table 4-1. In general, daily temperature fluctuations were larger within the Sandy River than within the Little Sandy or Bull Run Rivers (although data for only a single upstream site is available for the Little Sandy). The mean daily temperature fluctuation across all months and all sites for the Sandy River averaged 5.7 °F and ranged from a low of 3.1°F at site SR02 in August to a high of 8.3°F in September at site SR03. A maximum daily temperature fluctuation of 11.7°F was recorded in August at site SR04. This compares with Bull Run River, which averaged a mean daily temperature fluctuation across all sites and months of 2.9°F and ranged between a low of 2.4°F at site BR03 in August and September to a high of 3.8°F at site BR02 in August. A maximum daily temperature fluctuation of 7.5°F was recorded in August at site BR03. Mean daily temperature fluctuations were small within the tailrace of the Bull Run Powerhouse and were 2.1°F, 1.5°F, and 1.6°F for the months of July, August and September, respectively. No significant trend in mean daily temperature fluctuations was noted between sites above and below Marmot Dam. For the months of July, August, and September, mean daily temperature fluctuations were smaller at site SR02, below Marmot Dam, than at site SR01, above Marmot Dam. Mean daily temperature fluctuations at site SR03 averaged 6.37°F from July to September compared with

[1] Graphs of the SDMMDM for each site can be found in PGE 2002d, figures 5.2.2-2 through 5.2.2-10.

6.43˚F at site SR01. Although the average across these 3 months was similar between these 2 sites, the mean daily temperature fluctuation increased from July to September at site SR03 while it decreased at site SR01.

Flow diversion at the Marmot Dam is expected to affect downstream water temperature by reducing instream flow on the Sandy River. The Sandy River from its mouth to the Marmot Dam has been identified by the ODEQ 303(d) program as "Water Quality Limited" due to elevated summer water temperature (ODEQ 1998). This listing is based on ODEQ temperature data from the lower Sandy River (RM 3.1) for 1986-1995, which indicated that 12 of 34 summer water temperature measurements exceeded the ODEQ standard for rearing salmonids of 64 F. No violations of the ODEQ water temperature standard for rearing salmonids occurred between July 6 and October 6, 1999, either above Marmot Dam at site SR01 (RM 30) or below Marmot Dam at site SR02 (RM 23.9).

Table 4-1. Monthly mean, maximum, minimum, and standard deviations of daily temperature (°F) fluctuations for the months of July, August, and September, 1999, recorded for nine instream sites in the Sandy River Basin.

Site	Month	Mean Daily Temperature Fluctuation	Max. Daily Temperature Fluctuation	Min. Daily Temperature Fluctuation	Standard Deviation
SR01	July	7.7	11.5	1.9	2.5
	August	6.5	9.3	1.7	1.9
	September	5.1	7.5	2.2	1.3
SR02	July	4.0	7.5	1.4	1.6
	August	3.1	4.8	1.1	1.0
	September	3.6	5.8	1.9	0.9
SR03	July	3.9	6.4	0.8	1.3
	August	6.9	11.6	1.9	2.8
	September	8.3	11.4	3.9	2.1
SR04	July*	5.2	7.4	2.2	1.4
	August	7.2	11.7	2.2	2.9
	September	7.2	10.4	3.1	2.2
LS01	July	5.8	8.7	1.7	2.4
	August	5.2	7.9	1.1	1.9
	September	4.5	6.4	2.2	1.3
LS03	July	4.4	8.1	2.5	2.6
	August	5.6	8.5	1.7	1.7
	September	5.6	9.5	2.8	2.1
BR02	July**	NA	NA	NA	NA
	August**	3.8	6.8	1.4	1.4
	September	2.7	4.8	1.4	0.9
BR03	July	3.1	5.5	1.1	1.4
	August	2.4	7.5	0.9	1.5
	September	2.4	6.2	1.1	0.9
TR01	July	2.1	7.2	0.6	1.4
	August	1.5	4.8	0.3	0.9
	September	1.6	5.1	0.6	0.9

*Includes data beginning on July 10, 1999.
**July data were not collected and August data begins Aug. 14, 1999 due to theft of original data recorder.
Source: FERC 2003.

In addition, despite reductions in flow below Marmot Dam, the downstream change in temperature between these two sites was modest. The monthly average downstream increase in water temperature between sites SR01 and SR02 was -0.1°F in July, 0.4°F in August, and 1.1°F in September. This translates to a rate of change of -0.02°F per mile in July, 0.07°F per mile in August, and 0.2°F per mile in September. Water temperatures exceeded the ODEQ water temperature standard for rearing salmonids on 15 days at site SR03 (RM 18.4) between July 6 and October 4, 1999. The monthly average downstream increase in water temperature between sites SR01 and SR03 was 0.2°F in July, 3.6°F in August and 4.7°F in September. This translates to a rate of change of 0.02°F per mile in July, 0.3°F per mile in August, and 0.4°F per mile in September.

The Little Sandy Dam diverts all flow up to 800 cfs from the Little Sandy River to Roslyn Lake. There is no minimum flow release in the 1.7 mi reach below the diversion dam, and monthly median flows at the mouth of the Little Sandy range between 2 and 14 cfs (Andrus 1998). The SDMMDM temperature calculated for water temperatures above the Little Sandy Dam indicate that from July 6 through October 6, 1999, only a single value, recorded on August 4, exceeded the ODEQ water temperature standard.

Limited data exist for either a comparison of instream temperatures above and below the Little Sandy Dam, or above and below the tunnel which delivers diverted water from the Sandy River to the Little Sandy River. Hourly temperature data collected across a 72-hour period between May 11 and May 13, 1999, show an average downstream increase of 2.5°F between sites LS01 and LS04 during this period. Data collected at site LS02 includes 6 water temperature readings between August 17 and August 20, 1999. A comparison of these readings with those collected at site LS01 shows an average increase in water temperature of less than 1°F, suggesting only modest impacts of the diverted waters from the Sandy River on the Little Sandy River. This conclusion is supported with a comparison of the SDMMDM temperatures from above Marmot Dam (SR01) with those from above the Little Sandy Dam (LS01). The average temperature difference between these two sites from late June through early October was only 0.9°F, with a maximum difference of only 2.5°F.

Sites BR01 and BR02 are situated on the Bull Run River immediately above and immediately below the confluence with the Little Sandy River. A comparison of water temperatures at these two sites measured hourly from August 18 through August 20, 1999, reveals a significant difference in mean water temperature. Temperatures averaged 60.5°F above the confluence with the Little Sandy and 68.0°F below the confluence. This difference in mean water temperatures suggests that the Little Sandy River has a significant warming influence on the Bull Run River from the confluence with the Little Sandy (RM 4.1) to the Bull Run Powerhouse. Water temperatures at site LS01 averaged 59.4°F during the period of August 18 to August 20, 1999, suggesting that instream temperatures rose significantly below the Little Sandy Dam prior to entering the Bull Run River.

Water temperatures recorded between August 17 and 20, 1999, at the mouth of the flume just prior to entering Roslyn Lake (site LS03) indicated a moderate increase compared with temperatures recorded behind Little Sandy Dam (site LS02) for the same period. Temperatures increased from 59.6°F at site LS02 to 62.7°F at site LS03. This increase reflects a change in temperature of about 1.1°F per mile.

Flow diverted from both the Marmot Dam and the Little Sandy Dam is collected within Roslyn Lake and discharged through the Bull Run Powerhouse into the Bull Run River at RM 1.5. Water temperature in the lower Bull Run River, below the powerhouse, and in the Sandy River, below the confluence with the Bull Run, may be affected by powerhouse discharges. The Bull Run River from its mouth to the City of Portland's Reservoir No. 2 is identified by the ODEQ 303(d) program as "Water Quality Limited" due to elevated summer water temperature (ODEQ 1998).

Water temperature measurements were recorded in the tailrace of the Bull Run Powerhouse between July 8 and October 6, 1999. SDMMDM temperatures were within the ODEQ standard for salmonid rearing on all but four days in August. A maximum SDMMDM temperature of 64.5°F was reached on August 6, 1999. Water temperatures measured between August 18 and August 20 at site BR01 on the Bull Run River, above the confluence with the Little Sandy River, were only moderately cooler than water temperatures in the tailrace. Temperatures averaged 61.7°F in the tailrace compared with an average of 60.5°F at site BR01. During the 72-hour sampling period, a maximum temperature of 66.8°F was recorded at site BR01 on August 19.

The average daily maximum temperature for July 2 through October 6 differs very little between site BR03 and site TR01. Site BR03 had a daily maximum average of 59.9°F compared with 59.6°F at site TR01. With the SDMMDM temperatures recalculated for site BR03 - minus the 12 extreme values - site BR03 exceeded the ODEQ standard of 64°F on 4 days in early August.

ODFW (1997a) has stated concerns that warmer water entering from the mainstem Sandy River may act as a thermal barrier that may cause upstream migrating salmonids to be attracted into the cooler water of the Bull Run River. The average SDMMDM temperature from July 8 through October 6 at site SR03 was 61.8°F compared with 60.5°F at site BR03. The most pronounced difference in SDMMDM temperatures between site SR03 and BR03 occurred between August 19 and August 31, when the temperature was an average of 4.1°F higher at site SR03.

Roslyn Lake did not exhibit a temperature profile that would suggest it is a thermally stratified lake. In May, water temperatures decreased little with depth, going from 44.8°F at the surface to 44.4°F near the bottom (16 ft). Although a more significant decrease in temperature with depth was noted in August, no distinct thermocline was found. Temperatures decreased from 66.6°F at the surface to 58.3°F near the bottom. Surface water temperatures within Roslyn Lake on August 19 were an average 6.0°F and 6.1°F warmer than behind Marmot Dam or Little Sandy Dam, respectively. At the depth from which the penstocks withdraw water from Roslyn Lake, however, water temperatures were moderately cooler than those from behind Marmot and Little Sandy Dams, with an average decrease of 1.6°F and 1.5°F, respectively.

4.6 Summary

Some habitat requirements of the LCR chinook salmon and LCR steelhead ESUs are not being met under the environmental baseline (Table 4-2). Conditions within the action area, including some influenced by past Project effects, have contributed to the current status of the ESUs. Environmental baseline conditions in the action area would have to improve to meet those biological requirements. Any further degradation or delay in improving these conditions might increase the amount of risk that the listed ESUs presently face under the environmental baseline. Table 4-2 displays a summary of the relevant factors discussed in the above sections, based on the Matrix of Pathways and Indicators described in NOAA Fisheries (1996).

Road density is one factor described in Table 4-2 as not being properly functioning, but this status is largely due to influences other than the Project. Road density associated with the Project itself is limited.

Table 4-2. Correspondence between NOAA Fisheries' properly functioning conditions matrix and current baseline conditions.

NOAA Fisheries Properly Functioning Conditions Matrix			Current Baseline Conditions in Sandy River Basin	Status
PFC Pathway	**PFC Indicator**	**Properly Functioning Conditions**		
Water Quality	Temperature	50-57°F (10-14°C)	Summer temperatures in Sandy River exceeding 64°F (20°C)	Not properly functioning for salmon rearing or migration
	Sediment/ Turbidity	<12% fines in gravel, turbidity low	Turbidity levels are naturally moderate from glacial melt	Properly functioning
	Chemical Contamination/ Nutrients	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303(d) designated reaches	Low levels of chemical contaminants	Properly functioning
Habitat Access	Physical Barriers	Any manmade barriers present in watershed allow upstream and downstream passage at all flows	Passage provided at Marmot Dam, but not at Little Sandy Dam	Not properly functioning
Habitat Elements	Substrate	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20%	Gravel is limited below Marmot Dam	At risk
	Large Woody Debris (LWD)	>80 pieces/mile >24" diameter and >50 ft length	LWD relatively low in Sandy River	At risk
	Pool Frequency	100 ft channel; 18 pools/mile	Pool frequency is high in the Project area	Properly functioning
	Pool Quality	Holding pools > 1 meter deep with good cover and cool water, minor reduction of pool volume	Many pools> 1 meter deep, many good holding pools, particularly in Reach 2	Properly functioning

NOAA Fisheries Properly Functioning Conditions Matrix			Current Baseline Conditions in Sandy River Basin	Status
PFC Pathway	**PFC Indicator**	**Properly Functioning Conditions**		
	Off-channel Habitat	Backwaters with cover, and low energy off-channel areas	Over 20,000 ft of side-channel habitat in Sandy River below Marmot Dam	Properly functioning
	Refugia	Habitat refugia exist and are adequately buffered	Salmon River is a Northwest forest plan Tier 1 watershed, and Little Sandy and Bull Run Rivers are Tier 2 watersheds.	Properly functioning
Channel Conditions and Dynamics	Width/Depth Ratio	<10	Unknown	Unknown
	Streambank Condition	>90% stable	Unknown	Unknown
	Floodplain Connectivity	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland function, riparian vegetation and succession.	Vegetated floodplain habitat is frequent in Reaches 3,4, and 5	Properly functioning
Flow/ Hydrology	Change in Peak/Base Flows	Watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography.	Peak flows and base flows reduced in Sandy and Little Sandy Rivers, and increased in Bull Run.	Not properly functioning
	Increase in Drainage Network	Zero or minimum increase in drainage network density due to roads	Non-Project road density is high, likely increasing drainage network	Not properly functioning
Watershed Conditions	Road Density & Location	<2 mi/mi^2, no valley bottom roads	Non-Project road densities are 2-3 mi/mi^2	Not properly functioning

NOAA Fisheries Properly Functioning Conditions Matrix			Current Baseline Conditions in Sandy River Basin	Status
PFC Pathway	**PFC Indicator**	**Properly Functioning Conditions**		
	Disturbance History	<15% ECA with no concentration of disturbance in unstable or potentially unstable areas, and/ or refugia, and/or riparian area	Salmon River is a Northwest forest plan Tier 1 watershed, and Little Sandy and Bull Run Rivers are Tier 2 watersheds.	Properly functioning
	Riparian Reserves	The riparian reserve system provides adequate shade, LWD recruitment, and habitat protection and connectivity in all subwatersheds	Riparian vegetation varies considerably, but generally is healthy	Properly functioning

Source: PGE 2002c.

5. EFFECTS OF THE ACTION

This section includes an analysis of the direct and indirect effects of the proposed action on listed chinook salmon and steelhead and their habitats. The potential effects of the proposed action on listed species were discussed extensively during the settlement negotiations. Throughout these negotiations, the ESA Subgroup and the DWG relied on the best available science and technical expertise to make educated decisions and move negotiations forward. Initially, several removal strategies were under consideration. Through focused discussions, the use of technical experts, best available science, engineering feasibility evaluations, and consideration of human safety concerns, the ESA Subgroup and the DWG reached a consensus that one removal strategy would be most appropriate for this Project: a single-season removal with minimal sediment removal. Once this removal strategy was identified, additional modifications to the alternative (as originally proposed in the preliminary draft environmental assessment) were incorporated to further minimize impacts to ESA-listed species. The ESA Subgroup relied on the best available science, technical expertise, and professional judgment of its members to identify potential impacts and determine appropriate incidental take minimization actions and contingency measures.

As a result of these discussions, the ESA Subgroup developed the above-mentioned impact minimization and avoidance measures, several contingency measures, and numerous incidental take minimization actions, which were incorporated into the ESA Fish Monitoring and Contingency Plan (ESA Fish Plan), described in detail in section 4.6 of the Decommissioning Plan, and in section 3.4 of the BA. A major component of the ESA Fish Plan is the formation of the MIT. PGE, ODFW, NOAA Fisheries, and USFWS will each designate a representative to the MIT, which will oversee the implementation of the ESA Fish Plan. The ESA Fish Plan is designed to allow for immediate actions to be taken when risk to listed species is high, and for more deliberative actions to be taken when risk to listed species is lower, such as during non-peak periods of fish migrations.

The MIT will minimize incidental take of listed species, while allowing for modification in the monitoring activities as appropriate based on current information. The continued input of the MIT to these future monitoring plans ensures that decisions to implement protective measures for listed species will be based on the most up-to-date information, and will be relevant to the situation at hand. The MIT also will be responsible to concur with PGE's Endpoint Monitoring, which is described in section 3.4.2 of the BA and section 4.7 of the Decommissioning Plan. Endpoint Monitoring defines when the mainstem Sandy River channel has become stable and the potential for fish passage blockage due to downstream sediment deposition from dam removal has been lowered to baseline condition. Once there is concurrence from the MIT that the impacts of dam removal have been reduced to background levels, PGE's responsibility in the basin is complete. The ESA Fish Plan, MIT, and Endpoint Monitoring all ensure appropriate measures will be taken in the Sandy River to reduce and minimize incidental take, until such time that impacts from the dam removal are no longer present.

The overall Project decommissioning action as proposed by the SA was developed in an effort to eliminate or reduce, to the extent practicable, potential impacts to listed species and minimize incidental take of these species. NOAA Fisheries acknowledges that impacts and incidental take of listed species will likely occur from release of sediment behind Marmot Dam. However, these impacts are predicted to be relatively short-term. The long-term benefits provided by removal of the Marmot and Little Sandy Dams, such as a free-flowing river, removing fish passage impediments, and restoring fish access to currently blocked habitat, will improve conditions for listed fish species and promote recovery of listed fish stocks.

The effects of the proposed action are evaluated in three separate time periods: 1) existing operations prior to the amended license, 2) interim operations under the amended license until dam removal in 2007, and 3) dam removal (2007-2009) with post-removal monitoring and contingency plans through 2017 (or as determined by Endpoint Monitoring).

5.1 Effects of Continued Operations on Listed Species Prior to an Amended License

The direct and indirect effects of existing Project operations on listed species are described under baseline conditions in Section 4 and in much greater detail in the SA and BA. Continued operations of the Project under its existing license, 2002-2004, will result in continuation of baseline conditions until implementation of interim measures under an amended license. Several effects of the Project are minimized through ongoing conditions of the existing FERC license or PGE's voluntary actions. For upstream passage at Marmot Dam, PGE currently provides operations and maintenance for the fish ladder, and assists with sorting of the hatchery fish. The Marmot diversion canal is equipped with a fish screen and bypass system. For increased fish survival through this bypass system, the water elevations in the diversion canal are reduced during outmigration of salmonid fry. PGE also maintains minimum flows in the Sandy River mainstem, and avoids flow fluctuations below Marmot Dam. In the Little Sandy River, PGE operates the Project to minimize, if not eliminate, spill over the Little Sandy Dam to avoid attracting fish into an unsafe area where fish could be stranded once flows recede. PGE also provides hatchery compensation in lieu of minimum flows and fish passage at the Little Sandy Dam. At the Bull Run Powerhouse, a tailrace barrier prevents adult salmonids from entering the tailrace pool and encourages fish to move back into the Sandy River. Flow fluctuations are also reduced below the Bull Run Powerhouse. All of these actions serve to minimize incidental take of listed fish during operations under the existing license.

5.2 Effects of Interim Operations on Listed Species Under an Amended License

Interim operations represent a period from 2004-2007. A total of 25 potential interim Project operation effects were identified and discussed by the ESA Subgroup. Only two impacts were reasonably minimized; all other impacts were already addressed via voluntary PGE actions or FERC license conditions, or were not practicably avoidable (five effects were previously minimized by PGE; three were minimized via ESA Subgroup negotiations with PGE; ten were determined by the ESA Subgroup to be of minor effect [therefore no additional change was proposed] or, if modified, would result in greater effect; two were reviewed by the ESA Subgroup, negotiated with PGE, and abandoned due to minor effect; and five were determined by PGE to be unmodifiable due to operational, structural, or economic constraints).

The two interim measures were negotiated during settlement for implementation under the amended license. These measures, both of which address fish passage, are lowering diversion canal levels during fry outmigration to reduce impingement on the fish screen at Marmot Dam, and PGE's continuation of funding the operation and maintenance of the fishway at Marmot Dam, including sorting of hatchery fish. Hence, the effects of continued operations of the Project under an amended license will improve conditions over those discussed in Environmental Baseline (Section 4) and Continued Operations (Section 5).

5.2.1 Diversion Canal Water Levels

In its review of the ongoing impacts associated with existing operations, the ESA Subgroup identified impingement of fry on the traveling screen in the Marmot Dam diversion canal as a source of injury and mortality. ODFW (1999) reported an estimated 27% overall fish screen mortality on wild chinook salmon fry. Research conducted in the 1990s by PGE and ODFW biologists found that direct mortality due to impingement of spring chinook salmon fry was reduced when the water level in the diversion canal was reduced. To reduce the potential for fry impingement, PGE and the ESA Subgroup negotiated the following take minimization action:

PGE will lower Marmot Dam diversion canal water elevations from full capacity to 4.7 ft (1.4 m) from February 15 to March 1. Additionally, PGE will lower the canal water elevations to 4.2 ft (1.3 m) for 8 hours per day, beginning daily at sunset, between March 15 and May 15, and no greater than 4.7 ft for the remaining hours of these days.

NOAA Fisheries agrees that the proposed lowering of Marmot Dam diversion canal elevations, in concert with a fry migration timing monitoring effort (to allow modification of the March 15 start date), will minimize impacts to ESA species. For the lower canal elevation of 4.2 ft (1.3 m), it is estimated that 80% of the fry will use the bypass ports and not become impinged on the fish screen, resulting in a 10% to 45% improvement over impingement levels at higher diversion canal water elevations. Additionally, only 10% of outmigration occurs during daylight hours (ODFW 1999), so reducing canal water elevations to 4.2 ft for 8 hours at night will reduce impingement for 90% of the fry during peak outmigration.

This measure should benefit threatened LCR chinook salmon and LCR steelhead ESUs, and the LCR/Southwest Washington coho salmon ESU.

5.2.2 Fish Ladder Operation and Maintenance

The ESA Subgroup identified continued upstream passage at Marmot Dam for adult salmonids as a high priority during the interim operation period (2004-2007). Continued sorting of hatchery fish to exclude them from habitats above the dam was also a priority, because conversion of the Sandy River Hatchery to native stocks will not be complete until 2007. PGE currently provides operations and maintenance support for the ladder and assists ODFW with sorting hatchery fish under their existing FERC license. To ensure upstream passage and fish sorting was provided until dam removal, PGE and the ESA Subgroup negotiated the following action:

PGE will maintain the same effort on operations and maintenance of the ladder, as described in the current agreement between ODFW and PGE, and in the FERC license, during the period between expiration of the current FERC license and dam removal.

Passage conditions for anadromous salmonids will continue to benefit from maintenance of the fish ladder. This trap is used for sorting out hatchery fish and allowing only unmarked fish to pass upstream to the upper Sandy River watershed. The use of the trap should facilitate protection of native fish runs and greater harvest of hatchery fish. To avoid delays to migration, PGE is currently clearing the trap and transporting fish daily. At the time at which Marmot Dam and its fish ladder are removed, all hatchery introductions and progeny will be from wild Sandy River brood stock, and no sorting will be needed.

This measure should benefit threatened LCR chinook salmon and LCR steelhead ESUs, and the LCR/Southwest Washington coho salmon ESU.

5.3 Effects of Project Removal Activities on Listed Species

The direct and indirect effects of Project removal on listed and candidate species are described below. As previously stated, the relatively short-term impacts of the removal of Marmot Dam on ESA-listed fish species was the most complex and difficult issue that the ESA Subgroup and the DWG had to address. Through proactive discussions of these potential impacts and reliance on technical expertise and best available science, the ESA Subgroup was able to negotiate the removal strategy and include appropriate incidental take minimization actions and contingency measures, which were subsequently contained in the final proposed action described in the SA and the final BA.

The short-term impacts of Project removal include increased suspended sediment and other impacts associated with mechanized, instream-channel work; potential passage blockages to anadromous fish; impact to fall chinook salmon spawning habitat in the lower Sandy River; increased suspended sediment and aggradation in the mainstem Sandy, Little Sandy and Bull Run Rivers from release of accumulated sediment; changes in water quality; and potential river habitat alteration.

Long-term benefits of dam removal include restoration of Sandy River flow and elimination of partial fish passage barriers on the mainstem Sandy River, and restoration of river flow and elimination of complete fish passage barriers on the Little Sandy River. All of these factors contribute to improving the overall ecological integrity of the Sandy River Basin. These benefits will ultimately provide improved passage and habitat conditions for listed fish stocks and aid in their recovery.

Overall, removal of the Little Sandy Dam will restore access to approximately 6.5 mi (10.5 km) of upstream habitat and 1.7 mi (2.7 km) of habitat below the dam. Removal of Marmot Dam will restore natural flows to about 10 mi (16 km) of the mainstem Sandy River below the dam. Additionally, PGE will donate Project lands (~ 1,500 acres) to the Western Rivers Conservancy, and transfer Project surface water rights (600 cfs on the Sandy River and 200 cfs on the Little Sandy River) to an instream water right. The donated lands will help establish conservation corridors on the Sandy and Little Sandy Rivers. The Instream Water Rights will help ensure water availability for fish and wildlife benefits.

The effects of the decommissioning and Project removal have the potential to affect listed fish species; each of the potential impacts are discussed in detail in the following sections.

5.3.1 Beneficial Effects of Project Removal

In the long term, removal of the Marmot Dam will improve both upstream and downstream passage for anadromous salmonids occurring in the Sandy River. Project decommissioning and removal will reduce many of the effects the Project has had on Sandy River and Little Sandy River fish passage and fish habitat. Wild fish originating from the headwaters of the Sandy River will no longer have to negotiate the Marmot Dam fishway or suffer migration delays or handling stress associated with sorting migrating adult salmonids (Fagerlund et al. 1995). Thus any upstream passage inefficiencies associated with the Project will no longer affect the numbers of spawners reaching the headwaters. Additionally, the upstream movement of Sandy River fish will no longer be affected by the attraction of fish into the Bull Run River during generation periods (i.e., the "false attraction" issue identified during the initial relicensing scoping). This benefit is probably most significant when Sandy River flows are low.

Downstream passage impacts will also be removed. Mortality, stress, or injury associated with downstream passage facilities will be eliminated with the removal of Marmot Dam, resulting in increased survival of juvenile and adult (steelhead) downstream migrants and possibly contributing to increases in populations of species that currently migrate past Marmot Dam (primarily coho salmon, winter steelhead, and spring chinook salmon). The downstream bypass facility at Marmot Dam has been shown to cause high mortality of salmonid fry and currently does not meet ODFW criteria (ODFW 1997a). In addition, stress and injury associated with downstream passage at the dam by adult salmonids will be eliminated. Adult steelhead migrating downstream subsequent to spawning currently pass over the dam or through the downstream bypass system (Doug Cramer pers. comm. 2000). Dam removal will also eliminate any migration delay that may be associated with avoidance of the downstream bypass facility.

The removal of Little Sandy Dam will restore access to approximately 6.5 mi of historical anadromous habitat. Removal of Marmot Dam and Little Sandy Dam will restore a natural flow regime to the downstream reaches of the Sandy River and the Little Sandy River. Restoration of a river's natural flow regime, including the natural magnitude, frequency, duration, and timing of discharges, promotes biotic interactions, water quality, and physical habitat conditions that contribute to ecosystem integrity (Poff et al. 1997), and ultimately benefits salmonids. These types of ecosystem benefits, including benefits to anadromous salmonids, will be expected to occur in the Sandy River Basin with cessation of flow diversions at Marmot and Little Sandy Dams.

Restoring the natural hydrology at Marmot Dam will increase the frequency of certain discharge rates from the dam to the confluence with the Bull Run River. There will be no change in the discharge of high flows, since high flows are currently spilled over Marmot Dam (i.e., during high flow events, generating flows are diverted entirely from the Little Sandy River). The distribution of flows below the current minimum flows also will not change since no water is diverted when the Sandy River discharge falls below the minimum flow requirement. Ending water diversions will have the most prominent effect at intermediate flows – river flows above the current minimum flows. This will have the most effect from the end of the annual spring runoff until the beginning of the fall rains, the period when a significant proportion of the flow is currently diverted. No detailed analysis of the effects of flow increases on habitat for salmonids has been conducted, but restoring full flows throughout the year is expected to increase habitat availability by increasing the amount of wetted channel area. It will also change the quality of the habitat for salmonids by increasing the range of water velocity and depth. Changes in habitat will likely include increases in water depth in pools and in side-channel habitats, potentially increasing the suitability of these key habitat types for salmonids during certain times of year.

Similar benefits will be gained in the Little Sandy River and lower Bull Run River. Restoring the natural hydrology to the Little Sandy River will not only restore access, but provide flows in the lower section of the Bull Run River, potentially doubling the flow available in the lower Bull Run River during the summer and fall months. Most of the flow of the Bull Run River above the Little Sandy is diverted for water supply, hence restoration of Little Sandy flows will provide substantial habitat improvements.

In addition to changes in water velocity and depth, water temperatures downstream of Marmot Dam and downstream of Little Sandy Dam may decrease after the dams are removed, since increased flows will move water through these reaches more quickly, with less time for exposure to solar radiation and consequent heating. This temperature reduction could reduce the habitat for introduced warm water fishes found in the lower Sandy River, some of which are known predators on salmonids. In addition, adult holding and juvenile rearing habitat for fall chinook salmon, and other anadromous salmonids downstream of the dam site, will also be improved by reduced temperatures.

PGE's donated lands (~ 1,500 acres) will contribute to ecosystem integrity in the Sandy River Basin. These lands will help establish conservation corridors on the Sandy and Little Sandy Rivers, and will be managed for the protection and restoration of riparian habitat, river system integrity, and terrestrial wildlife corridors, as well as low impact public access consistent with the previous objectives. These lands will reduce habitat fragmentation and provide a more continuous riparian area, both of which promote ecosystem health and should improve conditions in the basin for listed species.

The conversion to an instream water right will ensure water availability for fish and wildlife benefits into the future, providing protection of these waters from future development and contributing to ecosystem health. The transfer of water rights will provide a 200 cfs instream right to the Little Sandy River and a 600 cfs instream right to the mainstem Sandy River. This conversion will provide protection for instream habitats, and improve conditions in the basin for listed species.

5.3.2 Removal of Marmot Dam: Selection of an Alternative

Removal of the Marmot Dam will result in free passage to headwater areas of the Sandy River, and increased river flow. However, there are potential impacts that could occur during removal and for several years afterward, and these impacts varied among the different removal alternatives. Initially during the settlement negotiations, several removal alternatives for Marmot Dam were under consideration by the DWG and the ESA Subgroup. Two of the alternatives required removing much of the accumulated sediment (900,000 cy and 730,000 cy) from behind the dam in a single season. However, the Sandy River immediately above Marmot Dam is fairly confined, with limited access points for heavy equipment to enter the channel and physically remove the sediment. An engineering feasibility study conducted early in the settlement negotiations estimated the most sediment that could physically be removed in one season during the inwater work period ranged from 150,000 cy to 300,000 cy, depending on environmental conditions. This information led the DWG to replace the two "maximum sediment removal" alternatives with one feasible alternative: a single-season removal with sediment removal of up to 300,000 cy. Two other alternatives were also under consideration at this time: a single-season removal with the minimal amount of sediment removed (20,000 to 30,000 cy), and a two-season removal with 370,000 cy of sandy material to be removed.

Upon examination by the DWG and the ESA Subgroup, a two-season removal alternative did not provide any certainty that more sediment could be removed, thereby minimizing downstream habitat and fish impacts after Marmot Dam removal. The upper Sandy River Basin naturally carries a high sediment load and is prone to glacial mudslides (lahars) that can dramatically increase the baseline sediment load. High flow events that occur in the winter and spring could potentially "replace" all the reservoir sediment removed in the first inwater work season. Fish passage for upstream migrating salmonids will also be blocked for two years; trap-and-haul methods will have to be used to move the fish around the dam. Trap and haul requires handling the fish, which increases stress, injury, and mortality of fish attempting to move upstream. All lifestages (adults, juveniles, eggs, and alevins) of listed salmonids below Marmot Dam during two-season removal will experience increased levels of turbidity, which can affect feeding, movement, and survival.

The DWG ultimately eliminated the two-season removal alternative for the above reasons, but the primary reason was that impacts from the dredging and deconstruction activities over two years will likely result in extended periods of poor passage and habitat conditions, increasing the amount of time fish were exposed to unfavorable conditions and thus increasing the incidental take. Salmonid populations in the Sandy River Basin have historically been exposed to episodic catastrophic events, as a result of the upper basin geology, and these salmonid populations have survived through these catastrophic events. Sandy River salmonid populations are better adapted to recover from these episodic events and better endure poor conditions and heavy impacts over a short period of time than extended poor conditions that will affect more year classes and migrations. Ultimately, the single-season removal was thought to be the best alternative to limit incidental take.

The two remaining alternatives were both single-season removal, and only differed in the amount of stored sediment to be removed from behind the dam. One alternative focused on the removal of a minimal amount of sediment (20,000-30,000 cy) to expose the structures to be removed. The second proposal relied on removing the greatest amount of sediment (300,000 cy) possible in a single inwater work season. Using a state-of-the-art model constructed for sediment transport in the Sandy River (Stillwater Sciences 2002), sediment deposition in the reaches below Marmot Dam for these two alternatives was compared. While the model indicated the alternative that removed as much sediment as possible did reduce deposition of sediment in the lower Sandy River reaches, the difference in sediment deposition between the two alternatives was statistically insignificant. Hence, the additional sediment removal was unlikely to substantially reduce impacts or incidental take of listed species, and the lower cost alternative was chosen by the DWG and the ESA Subgroup.

In this one-year, minimal sediment-removal methodology, a majority of the Marmot Dam sediment will be transported downstream during high flow periods. Marmot Dam and the old timber crib dam will be removed, but sediment will be removed only from about 400 ft (122 m) of river channel upstream of the dam. This will include the area of the old timber crib dam. Construction methods are described in more detail in the Decommissioning Plan, but will include placing cofferdams above and below the dam, diverting the stream flow through the approach canal, and installing a temporary fish trap barrier below Marmot Dam in the vicinity of the evaluator structure. Detailed analysis of the effects of stored sediment behind Marmot and Little Sandy Dams on downstream habitat during and following dam removal is provided in the "Evaluation of Geomorphic and Ecological Effects of Removal of Marmot and Little Sandy Dams" (Stillwater Sciences 2000a). The evaluation of geomorphic and ecological effects was based on sediment transport modeling for the ten-year period following dam removal. Based on sediment transport modeling (Stillwater Sciences 2000a) it is anticipated that sediment transport will be near natural rates within ten years.

5.3.3 Effects of Decommissioning and Project Removal on Salmonids

The objectives of Marmot Dam removal are to achieve unrestricted passage of listed fish species as soon as possible, maintain effective passage during removal, and minimize potential impacts from the release of sediment currently impounded behind Marmot Dam. Removal of the Marmot Dam will result in free passage to headwater areas of the Sandy River. Because much of the spawning and rearing areas for listed fish occurs above the dam, continuous and unrestricted passage is crucial to the recovery of these listed stocks. However, while dam removal activities are taking place in the river, and possibly for a period of time thereafter, there will be a temporary impact on upstream movement. Temporary fish passage measures will be in place during the removal of Marmot Dam to ensure both upstream and downstream passage during construction activities, thereby reducing incidental take during that time period.

As much of the sediment behind Marmot Dam will be mobilized once the dam is removed, potential formation of fish passage blockages from channel adjustment in the reservoir reach and increased sediment deposition downstream of the dam may affect listed fish. For these potential and unpredictable impacts, the ESA Subgroup developed the ESA Fish Plan, which requires monitoring to identify potential passage blockages, as well as appropriate responses to reduce these impacts and minimize incidental take. The ESA Fish Plan, the MIT, and Endpoint Monitoring all ensure appropriate measures will be taken in the Sandy River to reduce and minimize incidental take, until such time that the channel downstream of the dam has stabilized and that potential impacts from the dam removal are no longer likely to occur. These potential effects and the proposed contingencies to minimize incidental take of dam removal on fish passage are further discussed in the following sections.

5.3.3.1 Instream Construction Impacts

The use of heavy equipment within a river channel can cause potential impacts to fish, specifically increased turbidity, changes in water quality parameters, and introduction of toxic pollutants into the waterway. Increased turbidity and total suspended sediment (TSS) impact are discussed in detail in section 6.2.2 of the BE. For the removal of Marmot Dam, most deconstruction activities will be performed between the two cofferdams in the dewatered Sandy River channel. The only in-the-wet work consists of construction of the cofferdams. For the removal of Little Sandy Dam, all deconstruction will occur in the wetted channel during the low flow period, without the use of cofferdams. The incidental take that may occur during the removal process can be minimized using best management practices while working in the channel

Fish Salvage. The construction of cofferdams and temporary fish weir at Marmot Dam have the potential to trap and potentially strand adult and juvenile salmonids. Isolation and dewatering of the construction site has the potential to cause injury or death to fish trapped at the site. PGE has proposed to sequentially install the temporary fish trap and cofferdams to reduce the number of adult salmonids that may be trapped in the construction area. For those fish that are trapped in the construction area, PGE proposes to conduct a salvage operation, using appropriate handling and transport techniques, to reduce stress and minimize injury to salvaged salmonids. Adult fish will be transported upstream of the Project area in the Sandy River and juvenile fish will be released downstream. These measures should reduce the number of fish exposed to adverse conditions during construction of the cofferdams, as well as the number of fish requiring salvage between the cofferdams. The use of appropriate handling and transport techniques should reduce mortality, injury, and stress to salmonids associated with handling during salvage operations, and thereby minimize incidental take of listed salmonids.

Pollutants. Inriver work will require machinery to operate in close proximity to the river, introducing a chance for toxic contaminants to enter the river. Pollutants can be introduced into water bodies through direct contact with contaminated surfaces, or by the introduction of storm or wash-water runoff and can remain in solution in the water column or deposit on the existing bed material. Research has shown that exposure to contaminants reduces reproductive capacity, growth rates, and resistance to disease, and may lead to lower survival for salmon (Arkoosh et al. 1998 a, b).

Water Quality. Although the majority of work associated with the removal of Marmot Dam will occur in the dry between two cofferdams, the increase in TSS and sedimentation caused by the construction and subsequent removal of the cofferdam may affect water quality, which may in turn result in adverse effects to fish in the area. Inwater construction of the cofferdam at Marmot Dam and the removal of the Little Sandy Dam have the potential to affect water quality both in the immediate construction area and downstream. Draining and regrading Roslyn Lake could also result in short-term increases to TSS in the Bull Run and Sandy Rivers.

Construction activity is expected to increase TSS concentrations downstream of the dam during the excavation period. The magnitude of the increase in TSS concentration has not been determined but could be substantial, depending on measures implemented to control downstream release of sediment and turbid water. Increased TSS concentration downstream of Marmot Dam during the summer and early fall construction period could adversely affect adult and juvenile salmonids present in the lower river. Species, runs, and life stages potentially present downstream of the dam during this period include spring chinook salmon (adult and juvenile), fall chinook salmon (adult and juvenile), coho salmon (adult and juvenile), winter steelhead (adult [potential] and juvenile), and cutthroat trout (adult and juvenile). Adult spring chinook salmon, fall chinook salmon, summer steelhead, coho salmon (early hatchery run) and, potentially, winter steelhead, could be particularly vulnerable to increases in TSS concentration downstream of the dam during excavation, because significant portions of these populations could be expected to be holding or migrating through the lower river. In addition, fall chinook salmon spawning and incubation, which can begin as early as September and occurs primarily downstream of the dam, could be impacted by increased TSS concentration downstream. Fall chinook salmon juveniles, which rear almost exclusively downstream of the dam, and winter steelhead juveniles, originating from spawning downstream of the dam, will be most vulnerable to increases in TSS concentration during the construction season. Juvenile coho salmon, spring chinook salmon, and summer steelhead rearing in the lower river may also be affected, but the majority of juveniles of these species will be expected to occur upstream of the dam. Potential impacts caused by increases in TSS are discussed below in detail in Impacts of Downstream Total Suspended Sediment.

Removal of the dams may also affect other water quality parameters. Concrete dust can enter the waterway and cause short-term spikes in the pH. Typically, pH of rivers in the Sandy River Basin ranges from 6.5 to 8.5 (PGE 2002c). During the removal of Dinner Dam in the Row River Basin, pH rose to 10 during construction, and this level was maintained for several hours after deconstruction had stopped (G. Stewart, pers. comm., 2003). The removal of Marmot Dam will be confined to a dry channel, and the concrete dust and debris will be removed. Additionally, when water is reintroduced to the dam removal site, a significant volume of water (2,500 cfs) will be present and will likely dampen effects of residual concrete to pH.

Greater effects may be seen during the removal of Little Sandy Dam, as this dam will be removed in the wetted channel without cofferdams. However, relatively few fish are likely to be found in the Little Sandy below the dam during removal, and only juvenile and adult fish will be present in the Bull Run below the Little Sandy. Fish of this size will likely move to avoid these localized adverse pH conditions. The combined flow of the Little Sandy and the Bull Run Rivers may be sufficient to dampen increases to pH. Once the Bull Run River meets the mainstem Sandy River flow, the increases to pH will be further dampened, and possibly undetectable. Given the low numbers of fish expected to be present during removal, the limited habitat affected, and the accretion of flows, the effects to listed species will be relatively minor.

5.3.3.2 Removal of Marmot Dam

Once it was determined to only remove the minimal amount of sediment necessary to remove Marmot Dam, the ESA Subgroup negotiated modifications to this alternative to further minimize impacts to listed fish. Deconstruction activities will be limited to the inwater work period, and upstream migrating fish will be moved above the dam using trap and haul. Initially, the ESA Subgroup proposed construction of a pilot channel through the stored sediment; however, there were several construction limitations and human safety concerns that made this measure infeasible.

Negotiated incidental take minimizations, as committed to in the proposed action, include adjusting the timing of the cofferdam breaching, and construction of a larger upstream cofferdam. The cofferdam will be designed to withstand flows up to 2,500 cfs and will not be breached until the Sandy River flow above the dam is 2,500 cfs or greater. This measure was designed to ensure that when the stored sediment is exposed to flows greater than 2,500 cfs, the stored reservoir sediment will be quickly mobilized and a channel through the reservoir reach will be restored as quickly as possible, which should also rapidly restore fish passage through Reach 0 (Reservoir Reach). Flows of 2,500 cfs have a 70% chance of occurring in October and November (Stillwater Sciences 2002), which is a time period when relatively few anadromous fish are attempting to move into the upper watershed. Hence, moving the timing of breaching to when fewer listed fish are present further minimizes incidental take.

If flows do not reach the 2,500 cfs by the end of November, there is a greater than 90% chance of a 2,500 cfs flow prior to the end of December (Stillwater Sciences 2002). Such a delay will likely increase impacts to non-listed coho salmon destined for the upper watershed, and may possibly increase the impacts of eventual dam-released sedimentation on the fall chinook salmon spawning beds in the lower Sandy River. However, PGE will continue to provide passage around the deconstruction site until the upper cofferdam is breached. PGE has also committed to conduct a Fall Chinook Salmon Conservation Program (PGE 2002b, appendix B), which will ensure fall chinook salmon populations that rely on habitats in the lower Sandy River Basin will be protected from potential long-term adverse effects of sedimentation below Marmot Dam.

There were several potential impacts of Marmot Dam removal that could not be avoided. Most of these related to potential passage blockages, which could be caused by head cutting and bank sloughing in the reservoir reach, and sediment deposition causing passage blockages at side channels, tributary mouths, and the mouth of the Sandy River. For those impacts, the ESA Subgroup developed the ESA Fish Plan (see Appendix B) to minimize these impacts, should they occur. The ESA Fish Plan was then incorporated into the proposed action, and is described in greater detail in both the Decommissioning Plan (PGE 2002b) and the BA. Integral to the ESA Fish Plan is the involvement of the MIT, which will be responsible to guide the implementation of the ESA Fish Plan and any actions necessary as identified by the ESA Fish Plan. The ESA Fish Plan is designed to allow for immediate actions to be taken when risk to listed species is high, and for slower and deliberative action when risk to listed species is lower, such as during non-peak periods of fish migrations. The MIT will also be responsible to concur with PGE's Endpoint Monitoring, which defines when the mainstem channel has become stable, and when the potential for passage blockage due to downstream sediment deposition from dam removal has been lowered to baseline condition. Once there is concurrence from the MIT that the impacts of dam removal are reduced to background levels, PGE's responsibility in the basin is complete. The ESA Plan, MIT, and Endpoint Monitoring all ensure appropriate measures will be taken in the Sandy River to reduce and minimize incidental take, until such time that the channel downstream of Marmot Dam has stabilized and potential impacts from the dam removal are no longer likely to occur.

Impacts of Channel Adjustment in the Reservoir Reach (Reach 0). The majority of sediment stored behind Marmot Dam will be released downstream and the Reservoir Reach 0 will adjust to its pre-dam gradient over a period of years. However, the initial breach of the cofferdam, releasing 2,500 cfs, is anticipated to completely downcut a river channel through the reservoir sediment in 24 to 48 hours (Y. Cui, pers. comm., 2002). This channel is anticipated to provide fish passage above the dam site and through Reach 0.

This adjustment to the pre-dam gradient in the reservoir reach will result in the conversion of what are currently low-gradient habitats to higher-gradient habitats. As a result, the quality and/or quantity of currently existing Sandy River Reach 0 spawning habitats will be reduced. This will affect primarily fall chinook salmon. Also, rearing habitat suitability for spring chinook salmon, coho salmon, and summer steelhead will be reduced, but suitability for winter rearing of chinook salmon and steelhead, which utilize interstitial spaces in coarse substrates, may increase in the long term (i.e., after the channel adjusts to the new gradient and cobbles and boulders become more abundant).

The channel in the reservoir will continue to adjust to the removal of the dam over a period of several years, but some sediment will remain for a decade or more. During this period (especially the first few years following dam removal), channel instability and input of sand from bank erosion and mass wasting will likely make Reach 0 unsuitable for salmonid spawning or rearing. Redds constructed in Reach 0 will be highly vulnerable to burial and scour, resulting in low survival-to-emergence. Considering the short length of this reach and that most salmonid spawning occurs upstream or downstream of this reach, the impact of this temporary loss of habitat and permanent habitat conversion is expected to be relatively minor.

During the channel adjustment period in the reservoir reach, fish passage may be blocked from bank slumping or head cutting. The occurrence of a significant barrier could have substantial adverse impacts to salmonids that spawn in the upper watershed and must pass through this reach to arrive at their spawning grounds. Recent observations by researchers studying the geomorphic responses to dam removal have noted that newly formed river channels, eroding vertically through reservoir sediment, can down-cut onto bedrock, large wood, or other semi-permanent or permanent features that become exposed after dam removal (G. Stewart, pers. comm., 2003). The nick point of the head cut will remain perched on these non-erodible features, potentially causing a fish passage barrier, until the river channel erodes a new channel away from the barrier. The Marmot Dam removal methodology includes breaching the cofferdams at 2,500 cfs, which is anticipated to quickly form a new channel and may provide substantial force that will likely downcut around such a nick point or other non-erodible structure. Species and runs that will be most affected by impairment of passage include spring chinook salmon, winter and summer steelhead, and coho salmon. Fall chinook salmon spawn primarily downstream of the dam and, therefore, will not be as significantly affected by migration barriers through the reservoir reach. Large sediment deposits in the channel could also adversely affect downstream passage of juvenile salmonids during low flows, which typically occur from July through October. Blockage or impairment of downstream passage could affect downstream dispersal and outmigration of spring chinook salmon, summer and winter steelhead, and coho salmon.

As the new channel forms through the accumulated sediment, bank slumping into the newly formed river channel, channel down-cutting onto non-erodible materials, or other sediment blockages may pose barriers to upstream migration of adult salmonids, especially under low flow conditions. The likelihood that barriers to migration will form in this reach is uncertain and cannot be determined by the numerical modeling completed for this assessment. However, as part of the ESA Fish Plan, PGE has proposed to "shape" the reservoir sediment banks and cause slumping of high risk areas during high flow events following Marmot Dam removal, thereby minimizing or avoiding subsequent bank sloughing events, as described in section 6.2.2 of the BA.

As discussed in section 3 of the Decommissioning Plan, PGE's implementation of habitat impact minimization measures and implementation of the Monitoring and Contingencies Plan (Appendix B) will ensure that fish passage barriers in the reservoir reach (Reach 0), as identified by the depth, velocity, and distance criteria, will be rapidly and effectively addressed. Ensuring safe and successful fish passage through the reservoir reach will limit Marmot Dam removal impacts to suspended sediment and habitat alteration. In addition, PGE's Endpoint Monitoring will ensure that PGE continues its fish passage monitoring and contingencies efforts, until risk of fish passage blockage from Marmot Dam removal has ceased.

Impacts of Downstream Sediment Deposition in Reaches 1-5. Dam removal results in complex changes to downstream geomorphic and ecological functions and processes. The Sandy River below Marmot Dam has been characterized into five geomorphic reaches so the impacts of sedimentation can be better described (Stillwater Sciences 2000a). As downstream channels aggrade with reservoir sediment, changes in channel depth, velocity, pool volume, and habitat interact to influence listed fish survival. For instance, changes in substrate composition can influence fry, juvenile, and adult salmonids via changes in habitat type and availability, influence spawning success, and influence production of invertebrate prey for younger salmonid life stages (Reiser 1998). Additional discussion below describes listed fish impacts from Marmot Dam removal.

Coarse sediment released from the reservoir will be transported for shorter downstream distances than fine sediment; Stillwater Sciences' modeling (2000b) generally determined that coarse sediment will travel no farther downstream than Reach 3. Coarse sediment deposition can fill pools, and aggrade the riverbed. Rapidly aggraded coarse sediment can cause fish passage blockages. Coarse sediment deposition can also cause channel braiding, channel and floodplain aggradation, pool filling, and lateral point bar development. Fine sediment released from the reservoir will be suspended in the water column and cause high downstream turbidity. Fine sediment deposits can cover pool habitat substrate, and fill interstitial space in all habitat types, thereby decreasing hyporheic flows and altering ecologic function. Fine sediment will be transported into all Reaches (1-5) and into the Columbia River. Fine sediment will be apportioned into adjacent sediment storage areas, such as side channels and floodplain areas.

The majority of sediment stored behind Marmot Dam will be released and transported into downstream reaches of the Sandy River. During sediment mobilization and redistribution, potential fish passage blockages and impacts to spawning and rearing habitat may occur. Fish passage blockages are most likely to occur in Reaches 1 and 3, the upstream entrance to Reach 2 (the narrow gorge), and the downstream end of Reach 2 (where the gorge opens). Impacts to habitat may occur in all reaches, although habitat impacts within Reach 2, which is the gorge, are not anticipated. Habitat impacts in Reaches 3, 4, and 5 (especially Reach 4) are of greatest concern because of their importance for fall chinook salmon spawning and rearing.

Downstream of the dam, sediment deposition will be most significant in Reaches 1 and 3, and at the upstream and downstream end of Reach 2. For several years following dam removal (expected to be less than a decade), sediment deposition and subsequent channel instability in Reach 1 will result in the loss of nearly all salmonid habitat values. Fine sediment will fill interstitial spaces and cover pools in Reach 1, and coarse sediment will fill pools and aggrade the river channel. This reach is not known to be heavily used for spawning by any salmonid species, and, based on field work completed for this assessment, does not appear to provide a substantial amount of spawning habitat, although some spring chinook salmon spawning does occur here. The importance of this reach for juvenile rearing is unknown. Habitat suitable for juvenile rearing of coho salmon, spring chinook salmon, and steelhead is present, although the majority of rearing habitat for these species is believed to occur in the upper watershed.

Channel braiding and channel instability during the adjustment period following dam removal may hinder upstream migration of adult salmonids and downstream movement of juveniles, especially during low flow conditions. The likelihood of the formation of a barrier to passage of adult salmon cannot be determined; however, such a barrier could be reasonably expected to occur, especially at the sediment debris fan expected to form immediately downstream of the dam site. As discussed above, impairment of upstream migration will primarily affect spring chinook salmon, coho salmon, and steelhead. Impairment of downstream migration during low flow periods will primarily affect spring chinook salmon (which may be more likely to pass through this reach during early fall when flows are typically low).

Sediment deposition in Reaches 1 and 3 may also result in long-term changes to habitat characteristics. While these changes are not currently predictable, increases in channel gradient, loss of pool habitat, and loss of side-channel habitat (especially at Beaver Island) will likely occur. These changes in habitat may reduce habitat suitability for winter rearing of coho salmon and spring/summer rearing of coho salmon and spring chinook salmon.

In Reach 2, changes in habitat conditions following dam removal are expected to be minimal. Pools suitable for adult-holding habitat are not likely to substantially fill with sediment, and pools are of sufficient depth that, even if some sediment deposition occurs, they will remain usable by salmonids. Gravel-sized material suitable for spawning that enters the gorge is likely to be transported through the gorge quickly and deposited downstream. Sand is expected to travel through the gorge in suspension.

Passage problems may occur at the upstream end of Reach 2 where the entrance to the gorge can be quite narrow, and where several major boulder constrictions occur in the upper and middle reaches of Reach 2. The dense riparian vegetation on Beaver Island, which is composed of both soft and hardwood trees, may be scoured out and moved downstream with the breaching of the cofferdam and subsequent sediment transport. The trees could potentially get caught at the narrow entrances of the gorge or at downstream boulder constrictions, and create large debris jams, which would subsequently cause increased sedimentation above the jam. This sedimentation may eventually "fill in," creating a waterfall and blocking fish passage. Reach 2 is inaccessible to machinery, resulting in poor ESA Fish Plan response to fish passage blockage.

In Reach 3, sediment deposition is expected to be most significant in the upstream end of the reach (i.e., at the outlet of the gorge) and above the confluence with Cedar Creek. Habitat impacts may include loss of pool and side-channel habitat and creation of new lateral point bars. Little deposition is predicted to occur in the downstream portion of Reach 3. Habitat impacts may include fine sediment covering pool habitats and filling interstitial spaces, lateral point bar formation, and loss of some pools due to channel aggradation. Spawning in this reach is limited, but fall chinook salmon spawning has been observed upstream of Revenue Bridge and winter steelhead spawning has been observed in side channels near Cedar Creek. This reach also provides suitable summer and winter rearing habitat for fall chinook salmon and steelhead, and suitable summer rearing habitat for chinook salmon, coho salmon, and steelhead. Sediment deposition in this reach may reduce or degrade spawning habitat by: 1) burying spawning riffles, 2) reducing flow depth, 3) burying redds, 4) increasing the frequency and depth of scour, and 5) reducing substrate permeability. Loss of spawning habitat, destruction of redds, or reduced survival-to-emergence in this reach would primarily affect fall chinook salmon and winter steelhead. Other anadromous salmonid species are not expected to spawn in this reach. The magnitude of this impact is expected to be small because little spawning is thought to occur in this reach under current conditions. Filling of pools and side channels and deposition of sand into the channel bed would reduce rearing habitat quality for coho salmon, winter and summer steelhead, and spring chinook from the upper watershed, and fall chinook salmon and winter steelhead produced in this reach. The majority of juvenile coho salmon, winter and summer steelhead, and spring chinook, however, are believed to rear upstream of Marmot Dam, and the majority of juvenile fall chinook salmon and winter steelhead produced in the mainstem are expected to rear in Reaches 4 and 5.

Most of the potential habitat modifications from sediment release into the Sandy River are unavoidable. However, PGE's implementation of habitat impact minimization measures (see section 3 of Decommissioning Plan), and implementation of the Monitoring and Contingencies Plan (Appendix B) will ensure that fish passage barriers in Reach 1, lower Reach 2, and upper Reach 3, as identified by the depth, velocity, and distance criteria, will be rapidly and effectively addressed. Ensuring safe and successful fish passage will restrict Marmot Dam removal impacts to suspended sediment and habitat alteration. In addition, PGE's endpoint monitoring will ensure that PGE continues its fish passage monitoring and contingencies efforts, until risk of fish passage blockage from Marmot Dam removal has ceased.

In Reach 4, the depth of coarse sediment deposition is expected to be minor and concentrated at the heads of bars, in side channels, and at the mouths of streams where substantial debris fans occur. Reach 4 contains the primary spawning and rearing area for fall chinook salmon (in the mainstem Sandy) and important spawning and rearing habitat for winter steelhead; coho salmon and winter chinook salmon spawn and rear in tributaries to this reach. Juveniles produced upstream of the dam may also rear in this reach. Deposition of sand and coarse sediment in this reach may affect salmonid spawning and incubation by burying redds, reducing substrate permeability (if large amounts of sand accumulate in the channel bed), increasing the depth and frequency of scour, and blocking access to spawning tributaries. Deposition may affect rearing habitat by eliminating access to side channels, blocking access to non-natal tributaries that may be suitable for rearing, and impairing juvenile dispersal or emigration from tributaries to the mainstem. Based on the Stillwater Sciences (2000b) model results, effects on spawning substrates and interstitial spaces used for rearing are expected to be minor (especially given the high sand content of the bed subsurface under current conditions) and the potential for elimination of side-channel habitats or blockage of access to tributary habitats is considered to be small (due to the amount of time required for sediment to arrive to this reach, abrasion of sediment prior to its arrival, and the volume of sediment currently stored in this reach). If the model predictions are incorrect and deposition in this reach exceeds predicted levels, important fall chinook salmon and winter steelhead spawning and rearing habitat may be lost or degraded in the short or long term. Effects to other species and runs are expected to be small. Perched lahar deposits are stored in the river banks in the Oxbow Park area of Reach 4; if Stillwater Sciences (2000b) model results are incorrect, any Sandy River aggradation or lateral point bar formation from Marmot Dam sediment could result in lateral movement of the Sandy River channel, and resultant bank erosion and mass wasting of perched lahar sediment. If these lahar formations are released, additional aggradation of the Sandy River channel may occur, resulting in a "feedback loop" that may create additional downstream sedimentation and potential habitat changes. However, additional release of spawning-sized materials from lahar formations will have some positive effects by increasing spawning material and creating more side-channel spawning habitat.

To address these unknown effects in Reach 4, PGE is proposing to fund a Fall Chinook Salmon Conservation Program (SA, appendix B), to minimize the impacts of Marmot Dam removal on the 2007-2008 spawning and recruitment of fall chinook salmon in Reach 4 near Oxbow Park. Fall chinook salmon are the only species largely dependent on the lower Sandy River, with preferred spawning sites present in Reaches 4 and 5. Sand and other fine sediment may accumulate in Reaches 4 and 5, which may adversely affect the fall chinook salmon spawning beds by reducing the flow of water to incubating eggs and alevin, or by reducing emergence success. This program will collect and spawn wild fall chinook salmon in the fall of 2007, when the stored sediment will initially be released. These offspring will be raised in a hatchery and released as smolts, ensuring that impacts to the 2007 year class from sediment deposition will be reduced, and that long-term effects to the fall chinook salmon populations will be minimized. It is anticipated that this activity will ensure that Marmot Dam removal has limited short- and long-term impacts to mainstem spawning fall chinook salmon.

Coarse sediment deposition is not predicted to occur in Reach 5, but substantial sand deposition can be expected. This reach is used primarily as a migration corridor by most anadromous salmonids in the Sandy River, but it is also used by fall chinook salmon and winter steelhead for spawning and presumably rearing. Substantial aggradation in this reach could result in the creation of barriers to adult salmonid migration, especially under low flow conditions, which could affect all anadromous salmonids entering the river. Aggradation could also impair juvenile outmigration. In addition, deposition of sand may adversely impact fall chinook salmon spawning and incubation by: 1) burying redds, 2) increasing the frequency and depth of scour, and 3) reducing substrate permeability.

PGE's implementation of habitat impact minimization measures (see Decommissioning Plan, section 3), and implementation of the ESA Fish Plan (see Appendix B) will ensure that fish passage barriers in Reaches 4 and 5 will be rapidly and effectively addressed to the extent possible. Ensuring safe and successful fish passage will limit Marmot Dam removal impacts to suspended sediment and habitat alteration. PGE has also committed to fund a Fall Chinook Salmon Conservation Program in the first fall after removal, thus ensuring potential impacts to the spawning beds in Reaches 3, 4, and 5 are minimized. In addition, PGE's Endpoint Monitoring will ensure that PGE continues its fish passage monitoring and contingencies efforts, until risk of fish passage blockage from Marmot Dam removal has ceased.

Impacts of Downstream Total Suspended Sediment. Increased turbidity and TSS is anticipated during and following the removal of Marmot Dam. Model results indicate that TSS will increase during storm events, with higher peak concentrations in the first few years following removal, and lower peak contributions over time (Stillwater Sciences 2000b). However, impacts associated with increased turbidity and TSS after dam removal cannot be avoided.

Potential downstream increase in TSS concentration following dam removal was assessed using the numerical model (Stillwater Sciences 2000b). Release of sand and finer sediment from the reservoir will result in increased TSS concentration (relative to reference conditions) during high flow conditions occurring from November through June. Predicted TSS concentration does not change relative to the assumed reference condition during the summer and early fall (July through October). Increases in TSS concentration are predicted to be restricted to the Sandy River upstream of the Bull Run River confluence. Downstream of the Bull Run River, increases in TSS concentration are predicted to be minor due to dilution by inflow from the Bull Run River.

It is difficult to assess the potential impacts of the predicted increase in TSS concentration to adult and juvenile salmonids using information available in the literature. Numerous studies have evaluated the effects of acute and chronic exposure to elevated TSS concentrations for a variety of salmonid species. The results of these studies, however, are often contradictory, making it difficult to predict salmonid response to the range of TSS concentrations predicted by the Sandy River sediment model. The most commonly observed effects of exposure to elevated TSS concentrations on salmonids include the following: 1) avoidance of turbid waters in homing adult anadromous salmonids, 2) avoidance or alarm reactions by juvenile salmonids, 3) displacement of juvenile salmonids, 4) reduced feeding and growth, 5) physiological stress and respiratory impairment, 6) damage to gills, 7) reduced tolerance to disease and toxicants, 8) reduced survival, and 9) direct mortality. The severity of these effects depends on both the magnitude and the duration of the exposure. Many species can withstand extremely high TSS concentrations for short periods, but may suffer harmful effects when the exposure is prolonged (Herbert and Merkens 1961).

Newcombe and Jensen (1996) conducted a comprehensive review of the scientific literature on the effects of suspended sediment on numerous fish species. Based on their review, the authors developed an approach to evaluating and describing the severity of ill effects associated with exposure to a range of TSS concentrations. Based on this information, the predicted magnitude of the increase in TSS concentration could result in mortality of adult salmonids if exposure exceeded about 100 days. Exposure for less than 100 days is not expected to result in mortality, but could result in physiological stress and impaired homing. Elevated TSS concentration is expected to occur from November through June. Most adult salmon present in the river during this period are expected to pass through the affected reaches in a matter of weeks. Spring chinook salmon, however, may hold in the lower river for several months, but the majority of their holding period occurs when increased TSS concentration is not predicted (July through October).

For juvenile salmonids, the predicted increase in TSS concentration could result in short-duration physiological stress, reduced feeding rate, and reduced growth rate during extreme TSS peaks associated with high flow events. If increased TSS concentration persists longer than anticipated, these effects may increase in both magnitude and duration. Based on the Stillwater Sciences (2000b) model results, adverse effects on juveniles would be observed primarily upstream of the Bull Run River confluence. Salmonid species and life stages expected to be present in this reach during periods of elevated TSS concentration include spring chinook salmon (adult and juvenile), fall chinook salmon (adult and juvenile), coho salmon (adult and juvenile), winter steelhead (adult and juvenile), summer steelhead (juvenile [potential]), and cutthroat trout (adult and juvenile). Adult fall chinook salmon are expected to be found primarily downstream of the Bull Run River confluence, whereas upstream migrating adult spring chinook salmon, coho salmon, and steelhead are expected to pass through the affected reaches during periods of elevated TSS concentration. Juveniles of all species and runs could be present in these reaches during the affected period, but steelhead, coho salmon, and spring chinook salmon are expected to be found primarily in the upper watershed, and juvenile fall chinook salmon would be found primarily downstream of the Bull Run River confluence.

The sensitivity analysis conducted for the Stillwater Sciences (2000b) sand model provides bounds for interpreting the upper limit of impacts to salmonids potentially resulting from exposure to increased TSS concentration resulting from dam removal. The predicted increase in TSS concentration resulting from the ten-fold increase in the rate of delivery of sand and finer sediment from the reservoir could result in more severe impacts to adult salmonids, with some mortality expected to occur at exposure of about three weeks (during winter high-flow periods). Effects on juveniles is expected to be similar in nature, but potentially more significant in magnitude. The conclusions for both of these scenarios are indeterminate due to uncertainty in predicted TSS concentrations, lack of baseline TSS data in the Sandy River, and the variability in observed responses to exposure reported in the literature.

5.3.3.3 Removal of Little Sandy Dam

Little Sandy Dam will be removed during a single low-water season through a combination of blasting, excavation, and air hammers. Neither cofferdams nor temporary fish passage will be required during dam removal, because there are currently no anadromous fish populations utilizing the Little Sandy River.

Assessment of potential impacts to salmonid habitat in the Little Sandy River differs from assessment of impacts in the Sandy River because of the substantial differences in habitat suitability and access under current conditions. The lower Little Sandy River currently provides poor habitat for salmonids because over 90% of baseflows are diverted; access to the upper Little Sandy River from downstream of the dam is currently blocked because Little Sandy Dam does not have fish passage facilities. In contrast, the Sandy River currently supports good habitat for anadromous salmonids both upstream and downstream of Marmot Dam, and facilities for upstream and downstream passage for these species are provided at Marmot Dam. Although sediment release from Little Sandy Dam may result in some changes to habitat conditions, dam removal will substantially improve conditions for anadromous salmonids and other native aquatic organisms in the Little Sandy River by increasing flows and restoring connectivity with the upper basin. The analysis presented below focuses on potential sediment-related impacts of removing Little Sandy Dam and does not discuss the habitat benefits of restoring flows and access in the Little Sandy River, which, as noted above, are expected to far outweigh any adverse sediment-related effects.

Juvenile steelhead are currently found in the lower Little Sandy River (O'Neal and Cramer 1999), and surveys for this study suggest that steelhead, in particular, winter steelhead, are the anadromous salmonid species most likely to use this reach under full-flow conditions, given the lack of deep pools suitable for holding by adult summer steelhead. Coho salmon, spring chinook salmon, and cutthroat trout could also use this reach (mainly for rearing) with restored flows.

Migration, which is currently blocked by Little Sandy Dam, is not expected to be adversely affected by sediment release. Because of the relatively low volume of sediment stored behind Little Sandy Dam (~4,500 cy), it is unlikely that the sediment deposit or downstream aggradation resulting from sediment release will create a long-term physical barrier to fish passage following removal of the dam.

Aggradation in the downstream reach may limit its suitability for salmonid spawning in the short term, although, as noted above, such habitat is currently limited in this reach. Gravels deposited downstream of the dam will likely initially be highly mobile, potentially causing egg mortality if these gravels are used for spawning. The high sediment transport capacity in this reach will likely transport most substrates suitable for salmonid spawning downstream (and out of the Little

Sandy River) within a short period of time following dam removal. The sediment will then enter the Bull Run River, which is considered sediment depleted from the construction of dams by the City of Portland in the upper Bull Run River, which are operated primarily for water supply. The City of Portland dams are not part of the Bull Run Hydroelectric Project and its decommissioning and will not be discussed further.

Spawning habitat may increase near the downstream portion of Little Sandy Reach 1 following dam removal, where deposition of sediment released from the dam (as well as increased flows) may increase the suitability of existing alluvial deposits for spawning. Sediment released from Little Sandy Dam also will not likely substantially affect summer or winter rearing habitat for salmonids in Reach 1. Infilling of pools with coarse sediment may slightly reduce the suitability of these sites as adult-holding and juvenile-rearing habitat, but the riffle areas that predominate in this reach will likely remain suitable for rearing, even if short-term aggradation occurs.

Sediment released from Little Sandy Dam will not likely affect spawning or rearing habitat for salmonids in Little Sandy Reach 2 in the long term. No suitable spawning habitat currently occurs in the reach, and increases in gravel deposition as a result of the sediment pulse following dam removal will likely be short in duration because of the reach's high gradient. Riffles that are suitable for juvenile steelhead rearing (including coarse substrate interstices used for winter refuge) are not expected to be susceptible to sediment deposition impacts. In the long term, restoration of LWD transport and supply from the upper basin could increase the potential for gravel deposition and improve habitat conditions in this reach.

5.3.3.4 Removal of Canals, Tunnels, Flumes, and Ancillary Structures

The removal of the canals, tunnels, flumes, and ancillary structures will occur during the same two- to three-year construction period as removal of the two dams. Removing these structures should not affect listed fish species.

5.3.3.5 Project Powerhouse Removal

Removal of the powerhouse and appurtenant structures should not affect listed fish species.

5.3.3.6 Removal of Roslyn Lake

Draining of Roslyn Lake may result in increases in TSS and turbidity, which could result in adverse effects to listed salmonids in the lower Bull Run River. However, these effects are anticipated to be short term. Given the limited spawning available in the Bull Run River, few eggs, alevins, or sac fry are likely to be present. Other life stages of salmonids (juvenile, adult) that have greater swimming capabilities will likely move to avoid any significant TSS or turbid conditions.

5.3.3.7 Residual Effects of Dam Removal

Unavoidable adverse impacts to salmonids resulting from removal of Marmot Dam include: 1) increases in TSS concentration downstream of the dam during construction and after dam removal, 2) short-term impairment of adult upstream passage during dam removal and potentially following dam removal, 3) potential short-term impairment of juvenile downstream passage during and following removal, and 4) elimination of the opportunity to use the fish ladder at Marmot Dam as a fish-sorting facility.

However, the selection of 2007 for Marmot Dam removal is designed to reduce wild fish and hatchery fish interactions. The hatchery program for the Sandy River is managed by ODFW. Releases of hatchery spring chinook salmon, coho salmon, and winter steelhead into the Sandy River will continue to occur. The proposed actions include measures to separate hatchery origin steelhead and salmon at the Marmot Dam fish ladder and to transport and release marked hatchery salmon downstream until the dam is removed in 2007. This will reduce the number of hatchery chinook salmon reaching the watershed upstream of Marmot Dam, and will reduce competition and other interactions between wild and hatchery chinook salmon, thus providing a beneficial cumulative benefit to the species.

Adverse sediment effects are all expected to be short-term in nature, and will be minimized through the ESA Fish Plan (Appendix B), and PGE's Endpoint Monitoring. Based on sediment transport modeling, it appears that within ten years following dam removal, the sediment in the channel will be transported at natural rates. In addition, modeling also indicates fish passage barriers from sediment deposition are unlikely and, if they do occur, will be addressed via the ESA Fish Plan. In the long term, therefore, residual detrimental effects to fish and aquatic habitat from the Marmot Dam removal are expected to be insignificant and discountable, and beneficial effects, including restored flows and passage, will be significant.

TSS concentration downstream of Marmot Dam is expected to increase during construction for the entire dam removal. The magnitude of construction-related increases to TSS concentration could be reduced through implementation of measures to control the release of sediment and turbid water from the construction site. The magnitude of increased concentration resulting from delivery of sediment downstream following dam removal, however, likely could not be reduced through available measures.

6. CUMULATIVE EFFECTS

The ESA requires NOAA Fisheries to evaluate the cumulative effects of the proposed action on listed species and designated critical habitat and to consider cumulative effects in formulating biological opinions (50 CFR §402.14). The ESA defines cumulative effects as "those effects of future state or private actions, not involving federal activities that are reasonably certain to occur within the actions area" of the proposed action subject to consultation (50 CFR §402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 8 of the ESA. Federal actions, including hatcheries, fisheries, and land management activities are, therefore, not included. The cumulative effects analysis includes an assessment of the reasonably certain effects of future non-Federal activities that are cumulative to the direct and indirect effects of the proposed action as defined for the purposes of this Opinion. Thus the analysis includes a consideration of future non-Federal effects that may occur within the action area after Project removal has been concluded. The residual effects of dam removal – which are a part of the effects of the action analysis – are considered elsewhere as direct or indirect effects of the action. The area of cumulative effects analysis is defined as the Sandy River watershed.

A number of other commercial and private activities, including hatchery operations, recreation, urban and rural development, and water supply development, could potentially affect listed species occurring in the Sandy River Basin, as discussed below. PGE and NOAA Fisheries are not aware of any additional State or private action in the Project area that is reasonably certain to occur or that will affect the listed species or their critical habitat. It is likely that ongoing non-Federal activities that affect listed salmonids and their habitat will continue in the short term at similar intensities as in recent years.

About 78% of the basin is forested, with 75% of the forested lands occurring in the Mt. Hood National Forest (Taylor 1998). Activities on Federal lands are not included in the cumulative effect analysis, as described above. Land use in the remaining 22% of the basin, much of which occurs at lower elevations and is in private ownership, includes agriculture, grazing, and residential uses (ODFW 1997a).

6.1 Water Supply

The City of Portland's dams on the Bull Run River block delivery of coarse sediment from the Bull Run basin to downstream reaches, potentially affecting channel morphology and salmonid spawning habitat downstream of the dams. Field observations by Stillwater Sciences (2000b) indicate that the channel of the Bull Run River downstream of the City's dams is sediment depleted, as evidenced by areas where sediment deposition will be expected but the channel is scoured to bedrock. However, it is unlikely that changes in channel morphology resulting from water development within the Sandy River Basin will threaten the persistence of listed species occurring there.

6.2 Recreation

A variety of recreational opportunities are available in the watershed, including boating, fishing, camping, hiking, and others. Regulated fisheries for salmon, steelhead, and trout occur in the Sandy River Basin. The State of Oregon regulates salmon and steelhead harvest in the basin as outlined in the *Final Rule Governing the Take of 14 Threatened Salmon and Steelhead Evolutionarily Significant Units* (NOAA Fisheries 2000b). In general, NOAA Fisheries believes that State prohibitions on take of threatened steelhead and salmon in recreational fisheries are sufficient to not threaten the persistence of listed species (NOAA Fisheries 2000c).

6.3 Urban and Rural Development

Urban and rural development can contribute to riparian habitat fragmentation, water quality degradation (especially from non-point sources), and other impacts to salmonids and salmonid habitat. Much of the Sandy River watershed downstream of the Project is used for agriculture. The effects of agricultural and other rural development on salmonids and salmonid habitat in the Sandy River Basin will likely continue at current levels until issuance of the new Project license. It is unlikely that rural development within the Sandy River Basin will threaten the persistence of listed species occurring there.

The town of Sandy is the only urban area in the Project vicinity. Sandy is within 30 mi of the city of Portland, and is vulnerable to rapid development as Portland's population increases. The urban growth boundary, which designates a 20-year land supply, includes 1,178 acres (471.2 ha) in Sandy. It is unlikely that urban development within the watershed over the period until the new Project license is issued will threaten the persistence of listed species.

7. CONCLUSIONS

While the SA and Decommissioning Plan that are analyzed in this Opinion represent a complex program for dam removal and habitat restoration, several aspects stand out with regard to the protection of ESA-listed salmonid species. First, the timing of Marmot Dam removal allows ODFW's hatchery program in the basin to be modified to limit impact of hatchery fish on the basin's protected wild fish populations. Second, the single-season, minimum sediment removal approach to removal of Marmot Dam effectively limits the impact of deconstruction work on listed species. Third, the parties agreed on a statistically sound set of monitoring tools that will be applied after removal to assess whether the Sandy River has reached a point where the future risks to fish are minimal. This monitoring effort will ensure that FERC and its Applicant retain responsibility for the effects of Project removal until the Sandy River returns to proper function. Fourth, the Decommissioning Plan contains an extensive post-removal monitoring and contingencies plan. Fifth, the DWG agreed on a package of interim operating measures that are directly linked to an in-depth analysis of the Project's impacts to ESA-listed fish and are targeted at minimizing Project-related effects. In summary, the DWG used the best available information to design an action that seeks to avoid jeopardy to listed species, as well as minimize incidental take to those species.

The proposed Project decommissioning will result in a significant release of sediment into the Sandy River. This sediment will have both detrimental and beneficial effects, and the effects will vary spatially and temporally in the Project area. NOAA Fisheries anticipates that incidental take of listed fish species will occur. However, nearly every aspect of proposed Project operation and configuration represents a reduction or elimination of historical adverse effects of the Project, which influenced the habitat condition and species status under the environmental baseline. While a continuation of historical Project configuration and operation is explicitly excluded from the environmental baseline in the analysis of effects, these changes are likely to result in improved status of the local populations of the listed ESUs. In addition, the Sandy River Basin represents a small percentage of the overall populations and distribution of listed LCR chinook salmon and LCR steelhead. The wide occurrence of listed chinook salmon and steelhead in these ESUs will allow short-term, site-specific Sandy River effects to be buffered by the larger ESU distribution and population components.

While large scale, but short term, Sandy River habitat modifications will result from Project decommissioning, the decommissioning activities will not appreciably reduce the likelihood of survival and recovery for the listed ESUs. It is likely that both LCR chinook salmon and LCR steelhead will continue to survive, with the potential for recovery, during this time period, based on recent abundances and trends of the two extant populations in the action area (Section 3). Additionally, the large number of populations within these ESUs that are not found within the action area suggest that extinction of the ESUs is unlikely during this time period.

NOAA Fisheries therefore concludes that this action will not jeopardize the continued existence of LCR chinook salmon and LCR steelhead ESUs. No critical habitat has been designated for these species, therefore no determination of impact to critical habitat is included.

8. INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined in 50 CFR §222.102 as "an act that may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering." Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking, provided that such taking is in compliance with the Terms and Conditions of this Incidental Take Statement.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides RPMs that are necessary to minimize impacts and sets forth terms and conditions with which the Action Agency must comply in order to implement the RPMs.

8.1 Incidental Take Minimizations Identified in the Settlement Agreement

Decommissioning of the Marmot and Little Sandy Dams, which exist within the habitats of listed fish and wildlife species, has a high likelihood of causing incidental take to listed species. Section 7 of the ESA requires minimization of incidental take to listed species. The SA represents a final decision and commitment by signatories to the Bull Run Hydroproject Decommissioning Settlement Agreement, and FERC and its Applicant requested that the SA include all activities that will be required to comply with ESA Section 7. To the extent practicable, NOAA Fisheries agreed to this request and attempted to negotiate a SA that resulted in minimization of harm and avoidance of harassment to listed species.

By understanding the key concepts and requirements of Section 7 of the ESA, NOAA Fisheries was able to be proactive and protective, and complete a SA action that fully minimized incidental take of listed species. The following were key ESA Section 7 concepts and requirements that were adhered to during settlement negotiations:

- RPMs are considered reasonable and prudent when they are consistent with the proposed action's basic design, location, scope, duration, and timing.

- RPMs must involve Project actions within the Project action area, involve minor changes to the Project, and reduce the level of incidental take associated with the Project.

- Further, RPMs and Terms and Conditions should be developed in coordination with the Action Agency and Applicant to ensure the measures are reasonable, they cause only minor change to the Project, and they are within the legal authority and jurisdiction of the Action Agency or Applicant to carry out.

- RPMs serve to minimize impacts on the specific individuals and habitats affected by the action. Activities required by RPMs must occur within the action area.

- When practicable, attempts should be made to salvage specimens or habitat data from areas where there will be impacts.

NOAA Fisheries used knowledge of the proposed action, habitat conditions, and the listed species' life histories to identify habitat modifications that harm listed salmonids and negotiated final FERC and Applicant actions that minimized and avoided harm to listed species. In addition, NOAA Fisheries identified proactive and protective steps that FERC and its Applicant could undertake to avoid or minimize injury to listed species, thereby assuring the action does not harass the listed species (an act that harasses a listed species must have a likelihood of injury and some degree of fault, whether negligent or intentional). Thus if reasonable, proactive steps are taken to avoid or minimize injury to listed species, the action does not constitute harassment to the species).

Because NOAA Fisheries staff fully anticipated the potential for incidental take of listed species, and entered into extensive, upfront analysis and negotiations to identify and minimize incidental take from decommissioning of the Bull Run Hydroelectric Project, few additional minimization requirements within the final Incidental Take Statement are required. It is assumed by NOAA Fisheries, as per pages 10 to 11, section 6.2.2 of the SA, that FERC will adopt as license conditions the following RPMs and Terms and Conditions. It is also assumed by NOAA Fisheries that, as noted in section 6.2.2 of the SA, FERC's BA includes the entire action that consultation will occur upon, and therefore FERC will adopt as license conditions all activities identified in the Proposed Action section of the BA.

8.2 Amount and Extent of Anticipated Take

Interim Operations

NOAA Fisheries anticipates that interim Project operations will kill or harm some adult and juvenile LCR chinook salmon and LCR steelhead. Take will occur within the Sandy River Basin (i.e., upstream of the confluence with the Columbia River) from the date of signature through the initiation of dam removal operations. Interim operations represent a continuation of historic conditions, with changes in operations to reduce take of listed species as described in Sections 2.2.1 and 2.2.2 of this Opinion. NOAA Fisheries anticipates that incidental take of LCR chinook salmon and LCR steelhead will be difficult to detect and quantify because of the difficulties normally associated with detection of mortality or harm in river and reservoir conditions, i.e., turbidity, deep water, carcasses being swept downstream or taken by predators, and the high levels of effort needed to detect even a small percentage of injured or dead fish. NOAA Fisheries anticipates that the levels of take during interim operations will be less than, or equal to, levels of take occurring in the Sandy River Basin prior to the amended license taking effect. To further minimize take, NOAA Fisheries requires the implementation of the RPMs described in Sections 8.4-8.7.

Project Decommissioning
NOAA Fisheries anticipates that Project decommissioning operations will kill or harm some adults, juveniles, and incubating eggs of LCR chinook salmon and LCR steelhead within the Sandy River Basin from initiation through the completion of dam removal operations, with possible continuing effects. Likely causes of take include impeding fish passage, mobilization of silt and sediment, water quality degradation, and direct injury or mortality associated with construction activities. Changes in river morphology and silt and sediment input may cause take during the period following dam removal. NOAA Fisheries anticipates that incidental take of LCR chinook salmon and LCR steelhead will be difficult to detect and quantify because of the difficulties normally associated with detection of mortality or harm in river and reservoir conditions, i.e., turbidity, deep water, carcasses being swept downstream or taken by predators, and the high levels of effort needed to detect even a small percentage of injured or dead fish. To minimize take associated with Project decommissioning, NOAA Fisheries requires implementation of measures described in Section 2.2 and RPMs described in Sections 8.4-8.7.

If the proposed action results in take of a greater amount or extent than that described above, FERC would need to reinitate consultation. The authorized take includes only take caused by the proposed action within the action area as defined in this Opinion.

8.3 Effect of Anticipated Take

As analyzed in this Opinion and described in Section 5, NOAA Fisheries has determined that this extent of anticipated take will not jeopardize the continued existence of LCR chinook salmon and LCR steelhead.

8.4 Reasonable and Prudent Measures

RPMs are non-discretionary measures to minimize take, that are not already part of the description of the proposed action. They must be implemented as binding conditions for the exemption in Section 7(a)(2) to apply. FERC has the continuing duty to regulate the activities covered in this Incidental Take Statement. If FERC fails to require the Applicant to adhere to the Terms and Conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, or fails to retain the oversight to ensure compliance with these Terms and Conditions, the protective coverage of Section 7(o)(2) may lapse. NOAA Fisheries believes that activities carried out in a manner consistent with these RPMs, except those otherwise identified, will not necessitate further site-specific consultation. Activities which do not comply with all relevant RPMs will require further consultation.

NOAA Fisheries believes that the following RPMs are necessary and appropriate to minimize the effect of anticipated incidental take of LCR chinook salmon and LCR steelhead. FERC must require PGE to:

1. Use best available science to adaptively manage dam removal activity protocols to minimize listed species incidental take.

2. Ensure all dam removal and other decommissioning inwater and near-water construction activities are conducted in a fashion that minimizes impacts to aquatic and riparian resources.

8.5 Terms and Conditions

In order to be exempt from the take prohibitions of Section 9 of the ESA and regulations issued pursuant to Section 4(d) of the ESA, FERC must include in the new license, and PGE must implement, the following Terms and Conditions, which implement the RPMs listed above. These Terms and Conditions are non-discretionary.

8.5.1 Term and Condition 1

To implement RPM 1, above, FERC must require PGE to:

a. In spring 2007, convene the ESA Fish Monitoring and Implementation Team (PGE, USFWS, NOAA Fisheries, and ODFW) and other DWG members to review the dam removal activities and review any new information for potential impacts that were not considered during consultation. If new methods of avoiding and/or minimizing incidental take are identified, or if new information indicates proposed decommissioning and monitoring activities are not necessary, the ESA Subgroup shall use an adaptive management process to discuss and finalize take minimization activities before decommissioning activities commence. Changes to the Project's proposed action or this Incidental Take Statement shall be completed via simple amendment of this Opinion.

   Issues to be specifically reviewed in 2007 prior to decommissioning activities include:

   1. All new and ongoing habitat and fisheries monitoring and assessment information, including baseline, endpoint, and ESA contingencies monitoring information.

   2. Oregon State University evaluation of sediment impacts from Marmot Dam removal, including prediction of sediment transport and storage areas, future locations of stored sediment, fish habitat modifications, fish passage blockage, channel migration and bank erosion, and post-dam removal monitoring and contingency needs.

3. Potential effects of large wood (soft and hardwood species, both live and dead) that could be mobilized from Reach 1 upon Marmot Dam removal, and cause temporary and long-term downstream fish passage barriers in Reach 2.

8.5.2 Term and Condition 2

To implement RPM 2, above, FERC must require PGE to:

a. Best management practices shall be used to prevent concrete products (dust, chips, larger chunks) mobilized by dam removal activities from entering flowing or standing waters. Concrete-tainted wastewater shall be disposed of away from flowing or standing water. Best practicable efforts shall be made to collect and remove all concrete products prior to rewatering of construction areas.

b. Construction activities associated with habitat enhancement and erosion control measures shall meet or exceed best management practices and other performance standards contained in the ODEQ National Pollutant Discharge Elimination System (“NPDES”) 1200-CA permit (General NPDES Stormwater Discharge Permit).

c. Erosion control and sediment containment devices shall be employed at the Marmot Dam and Little Sandy Dam construction sites. All erosion control and sediment containment devices shall be inspected weekly, at a minimum, during dam removal to ensure that they are working adequately. Any erosion control or sediment containment inadequacies will be immediately addressed until properly functioning.

d. Erosion control and sediment containment materials (e.g., silt fence, straw bales, aggregate) in excess of those installed shall be available on site for immediate use during emergency erosion control needs.

e. Vehicles operated within 150 ft of the construction site waterways will be free of fluid leaks. Daily examination of vehicles for fluid leaks is required during periods operated within or above the waterway.

f. During construction activities, no pollutants of any kind (sewage, waste spoils, petroleum products, etc.) shall come in contact with the water body nor their substrate below the mean high-high water elevation or 10-year flood elevation, whichever is greater.

g. Any areas used for staging, access roads, or storage are to be evacuated, and all materials, equipment, and fuel shall be removed if flooding of the area is expected to occur within 24 hours.

h. Vehicle maintenance, refueling of vehicles, and storage of fuel shall be done at least 150 ft from the waterway, provided, however, that cranes and other semi-mobile equipment may be refueled in place.

i. At the end of each work shift, vehicles shall not be stored within, or over, the waterway.

j. Prior to operating within the waterway, all equipment shall be cleaned of external oil, grease, dirt, or caked mud. Any washing of equipment shall be conducted in a location that shall not contribute untreated wastewater to any flowing stream or drainage area.

k. Temporary erosion and sediment controls will be used on all exposed slopes during any hiatus in work exceeding 7 days.

l. Material removed during excavation will only be placed in locations where it cannot enter sensitive aquatic resources.

m. Alteration or disturbance of the streambanks and existing riparian vegetation will be minimized to the greatest extent possible.

n. No herbicide application shall occur as part of this action. Mechanical removal of undesired vegetation and root nodes is permitted.

o. Clearing limits shall be identified and marked. Construction activity or movement of equipment into existing vegetated areas shall not begin until clearing limits are marked.

p. All existing vegetation within 150 ft of the edge of the bank should be retained to the greatest extent practicable.

8.6 Fish Salvage at Marmot Dam

Fish salvage operations will be conducted for salmon and steelhead trapped between the temporary weir and Marmot Dam, and between the cofferdams. Fish salvage methods, as proposed in Section 2.2.3.1 of this Opinion, shall be carefully followed.

8.7 Reporting Requirements

In the Decommissioning Plan, sections 7.3.2, 7.3.3, and 7.3.4 provide details on monitoring reports that will be submitted to NOAA Fisheries after Immediate Response, Deliberative Response, or Endpoint Response actions are implemented by FERC or its Applicant. Section 7.3.5 of the Decommissioning Plan provides a detailed description of the annual monitoring report that will be provided to the MIT. These monitoring reports will fulfill FERC's requirements for notifying NOAA Fisheries when the amount or extent of incidental take is approached or exceeded (50 CFR §402.14(i)(1)(iv) and (i)(3)).

If a sick, injured, or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at (360) 418-4246. The finder must take care in the handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

9. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information. NOAA Fisheries has no conservation recommendations to make at this time.

10. REINITIATION OF CONSULTATION

As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded, 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion, 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

NOAA Fisheries and PGE have entered into the SA to facilitate issuance of a new license for the Project, and to finally resolve resource-related issues pertaining to the new license. FERC's DEIS contemplates incorporation of this SA into a final license order and license articles for the Project. In the event that the final license fails to incorporate the requirements of the agreement analyzed in this Opinion, FERC may be required to reinitiate consultation under Section 7 of the ESA.

11. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

11.1 Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)); NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)); Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR §600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), or site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR §600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

11.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally-managed Pacific salmon: chinook (*Oncorhynchus tshawytscha*);

coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Take of these species, chinook salmon and coho salmon, are affected by the proposed action. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable manmade barriers (as identified by the PFMC 1999), and long-standing, naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

11.3 Proposed Actions

The proposed action and action area are detailed above in Section 2 of this Opinion. The action area includes habitats that have been designated as EFH for various life-history stages of coho salmon and chinook salmon.

11.4 Potential Effects of the Proposed Action on Salmonids

Removal of Project facilities would result in short-term and long-term environmental impacts, the most important of which include:

- Short-term impacts to downstream aquatic and salmonid habitats, including listed salmon and steelhead species, as a result of sediment deposition in the Sandy River downstream of Marmot Dam, resulting in blockage to upstream fish passage, tributary passage due to sediment deposition, burying of spawning beds, loss of mainstem habitat for juvenile fish, and sedimentation and turbidity.
- Short-term increases in turbidity in the Little Sandy River.

11.5 Conclusion

NOAA Fisheries concludes that the proposed action would adversely affect designated EFH for coho salmon and chinook salmon.

11.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. While NOAA Fisheries understands that the conservation measures described in the BA will be implemented by FERC and, through its license, PGE, it does not believe that these measures are sufficient to address the adverse impacts to EFH described above. However, the Terms and Conditions outlined in Section 8 are generally applicable to designated EFH for coho salmon and chinook salmon, and address these adverse effects. Consequently, NOAA Fisheries recommends that they be adopted as EFH conservation measures.

11.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR §600.920(j), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

11.8 Supplemental Consultation

FERC must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR §600.920(k)).

12. LITERATURE CITED

Andrus, C. 1998. Accretion flow downstream of the Little Sandy diversion. Prepared for Hardin-Davis, Inc. for Portland General Electric, Portland, Oregon.

Arkoosh, M. R., E. Casillas, E. Clemons, A. N. Kagley, R. Olson, P. Reno, and J. E. Stein. 1998a. Effect of pollution on fish diseases: potential impacts on salmonid populations. Journal of Aquatic Animal Health. 10:182-190.

Arkoosh, M. R., E. Casillas, P. Huffman, E. Clemons, J, Evered, J. E. Stein, and U. Varanasi. 1998b. Increased susceptibility of juvenile chinook salmon from a contaminated estuary to *Vibrio anguillarum*. Transactions of the American Fisheries Society. 127: 360-374.

BRT (Biological Review Team). 2003. Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. Co-manager review draft. NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington. February.

Cramer, D. P. 1993. Evaluation of the Marmot Canal downstream migrant bypass system. Final report. Portland General Electric, Portland, Oregon.

Cramer, S. P., J. S. Hogle, and D. Simmons. 1998. Fish and habitat survey of the lower Sandy and Bull Run rivers. Prepared by S. P. Cramer & Associates, Inc., Gresham, Oregon, for Portland General Electric and Portland Water Bureau, Portland, Oregon.

Cramer, D. P. 1998, 1999, 2000. Personal communication. Portland General Electric Company, Portland, Oregon.

Cui, Yan Tao. 2002. Personal communication. Stillwater Sciences, 850 G Street, Suite K, Arcata, CA 95521.

Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile chinook salmon and steelhead trout in two Idaho streams. Journal of the Fisheries Research Board of Canada 29: 91-100.

Fagerlund, U. H. M., J. R. McBride, and I. V. Williams. 1995. Stress and tolerance. Pages 461-503 *in* C. Groot, L. Margolis and W. C. Clarke, editor. Physiological ecology of Pacific salmon. University of British Columbia Press, Vancouver.

FERC (Federal Energy Regulatory Commission). 2003. Bull Run Project, Oregon (FERC Project No. 477-024). Draft Environmental Impact Statement FERC/DEIS - 0162D. FERC, Office of Energy Projects, Washington, D. C.

Hardin, T. 1998. Instream flow analysis for the Little Sandy River from the PGE diversion dam to the Bull Run confluence. Prepared by Hardin-Davis, Inc. for Portland General Electric, Portland, Oregon.

Herbert, D. M. W., and J. C. Merkens. 1961. The effects of suspended mineral solids on the survival of trout. International Journal of Air and Water Pollution 5: 46-55.

Myers, J., C. Busack, D. Rawding, and A. Marshall. 2003. Historical population structure of Willamette and Lower Columbia River Basin Pacific salmonids. Portland, Oregon. 167 pages.

NOAA Fisheries (National Marine Fisheries Service). 1996. Making Endangered Species Act determinations of effect for individual and grouped actions at the watershed scale. Habitat Conservation Division, Portland, Oregon.

NOAA Fisheries (National Marine Fisheries Service). 1999. The habitat approach: implementation of Section 7 of the Endangered Species Act for actions affecting the habitat of Pacific anadromous salmonids. Northwest Region, Portland, Oregon.

NOAA Fisheries (National Marine Fisheries Service). 2000a. Designated critical habitat: critical habitat for 19 evolutionarily significant units of salmon and steelhead in Washington, Oregon, Idaho, and California. Federal Register 65: 7764-7787.

NOAA Fisheries (National Marine Fisheries Service). 2000b. Endangered and threatened species; final rule governing take of 14 threatened salmon and steelhead evolutionarily significant units (ESUs). Federal Register 65: 42421-42481.

NOAA Fisheries (National Marine Fisheries Service). 2000c. Biological opinion on the impacts from the collection, rearing, and release of salmonids associated with artificial propagation programs in the upper Willamette spring chinook and winter steelhead evolutionarily significant units. Endangered Species Act Section 7 Consultation. Prepared for U. S. Army Corps of Engineers and Bonneville Power Administration by NOAA Fisheries, Northwest Region, Portland, Oregon.

Newcombe, C. P., and J. O. T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16: 693-727.

ODEQ (Oregon Department of Environmental Quality). 1998. Public comment draft 1998 water quality limited streams - 303(d) List.

ODFW (Oregon Department of Fish and Wildlife). 1990. Sandy River subbasin salmon and steelhead production plan. Portland, Oregon.

ODFW (Oregon Department of Fish and Wildlife). 1997. Sandy Basin fish management plan. Draft. Portland, Oregon.

O'Neal K. and Cramer S. P. 1999. Fish and Habitat Survey of the Lower Sandy and Bull Run Rivers. Prepared for Portland General Electric.

PFMC (Pacific Fishery Management Council). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon. Portland, Oregon.

Poff, N. L., J. D. Allan, M. B. Bain, J. R. Karr, K. I. Prestergaard, B. D. Richter, R. E. Sparks, and J. C. Stromberg. 1997. The natural flow regime: a paradigm for river conservation and restoration. BioScience 47: 769-784.

PGE (Portland General Electric). 1996. Hydro relicensing strategy for addressing westside fish issues. Draft. PGE, Portland, Oregon.

PGE (Portland General Electric). 1998a. Helicopter survey of the Sandy River from Marmot Dam to the I-84 bridge. PGE, Portland Oregon.

PGE (Portland General Electric). 1998b. Initial information package for the Bull Run Hydroelectric Project FERC No. 477. Portland, Oregon.

PGE (Portland General Electric). 2002a. Surrender Application for the Bull Run Hydroelectric Project. FERC Project No. 477. Portland, Oregon.

PGE (Portland General Electric). 2002b. Settlement Agreement Concerning the Removal of the Bull Run Hydroelectric Project. FERC Project No. 477. Portland Oregon.

PGE (Portland General Electric). 2002c. Bull Run Hydroelectric Project, Draft Biological Evaluation. Portland, Oregon.

PGE (Portland General Electric). 2002d. Draft Environmental Assessment for the Removal of the Bull Run Hydroelectric Project. FERC Project No. 477. Portland, Oregon.

PGE and FERC (Portland General Electric and Federal Energy Regulatory Commission). 2000. Preliminary Draft Environmental Assessment for the Bull Run Hydroelectric Project, FERC Project No. 477. PGE, Portland, Oregon and FERC, Office of Hydropower Licensing, Washington, D.C.

Reiser, D.W. 1998. Sediment in gravel bed rivers: ecological and biological considerations. p. 199-228. In: P.C. Klingeman, R.L. Beschta, P.D. Komar, and J.B. Bradley [eds.]

Gravel-Bed Rivers in the Environment. Water Resources Publications, High land Ranch, Colorado. 832 p.

Squier Associates. 2000. Sandy River sediment study. Bull Run Hydroelectric Project, FERC Project No. 477. Prepared for Portland General Electric, Portland, Oregon. by Squier Associates, Lake Oswego, Oregon.

Stewart, Gregory. 2003. Department of Geosciences, Oregon State University, 104 Wilkinson Hall Corvallis, OR 97331. Personal Communication.

Stillwater Sciences. 2000a. Evaluation of Geomorphic and Ecological Effects of Removal of Marmot and Little Sandy Dams. Preliminary Draft Technical Report. Prepared for Portland General Electric.

Stillwater Sciences. 2000b. Numerical modeling of sediment transport in Sandy River, Oregon following removal of Marmot Dam. Technical Report. Prepared for Portland General Electric.

Stillwater Sciences. 2002. Preliminary Analysis on Coffer Dam Breaching Flows for the Marmot Dam Removal Project. Draft Technical Memorandum. Prepared for Portland General Electric.

Taylor, B. 1998. Salmon and steelhead runs and related events of the Clackamas River basin-a historical perspective. Prepared for Portland General Electric, Portland, Oregon.

USFWS and NOAA Fisheries (U. S. Fish and Wildlife Service and National Marine Fisheries Service). 1998. Endangered species consultation handbook: procedures for conducting consultation and conference activities under Section 7 of the Endangered Species Act. Final report. Washington, D. C.

USFS (U.S. Forest Service). 1993. Salmon national wild and scenic river management plan. Mt. Hood National Forest.

Ward, D. L., and T. A. Friesen. 1998. Evaluation of the Marmot Canal downstream migrant bypass system, 1998. Oregon Department of Fish and Wildlife, Clackamas, Oregon.

Appendix A

Direct, indirect, and cumulative effects of interim Bull Run Hydroelectric Project operations on protected salmonid populations, measures for reducing Project effects, and ESA Subgroup rationale for agreement points.

Table A-1. Direct, indirect, and cumulative effects of interim Bull Run Hydroelectric Project operations on protected salmonid populations,[1] measures for reducing Project effects, and ESA Subgroup rationale for agreement points.

Project Feature/ Proposed Action Effect Pathway/	Indicator	Potential Effects	Proposed Measures and Studies to Address Effects on Listed Salmonids	Rationale for ESA Subgroup Agreement Points for Interim Operations
Marmot Diversion Dam	Habitat Elements	**Indirect Effect**: Reduction of flows downstream of dam when diversion is operating (flows in Little Sandy River <800cfs), reduces available channel habitat, and floodplain habitat.	**Existing Measures**: Minimum flows below dam. IFIM studies have been conducted. No flow fluctuations occur except during emergency shutdowns. **Short-term**: No change anticipated.	PGE has previously initiated minimization actions.
		Indirect Effect: Reduced supply of gravel and large woody debris (LWD).	**Existing Measures**: Reservoir is filled to capacity and sediment and LWD are no longer stored. **Short-term**: No change anticipated.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations.
	Habitat Access	**Direct Effect**: Fish may be delayed during upstream or downstream migration.	**Existing Measures**: Equipped with a fish ladder for upstream passage. Recent improvements were made to the sorting facilities. A juvenile bypass facility exists in the diversion canal for downstream passage. **Interim Measure**: No other physical improvements are necessary for the short-term. However, PGE does commit to maintain the same effort on Operations and Maintenance of the ladder, as described in the current agreement between ODFW and PGE, during the period after their current FERC license expires and before dam removal.	ESA Subgroup and PGE successfully negotiated continued effect minimization.
	Flow/ Hydrology	**Indirect Effects:** Ramping (stranding, entrapment, repeated ramping may force juveniles into sub-optimal habitat or early outmigration).	**Existing Measure:** No flow fluctuations occur, except during emergency shutdowns. **Short-term:** No change anticipated.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations.
	Water Quality	**Indirect Effects**: Reduced flows may result in increased temperature downstream of dam.	**Relevant Studies:** PGE collected temperature data. **Short-term:** Project effects on temperature are relatively small and cannot be effectively corrected through operations.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations.

Project Feature/ Proposed Action Effect Pathway/	Indicator	Potential Effects	Proposed Measures and Studies to Address Effects on Listed Salmonids	Rationale for ESA Subgroup Agreement Points for Interim Operations
Marmot Diversion Dam Fish Bypass Facility	Habitat Access	**Direct Effect:** Delay, injury, or mortality of outmigrating fish due to entrainment and/or impingement occurring within bypass facility. ODFW 1999 reported an estimated 27% overall mortality on wild fish less than 60mm fork length.	**Existing Measure:** Maximum canal water surface elevations are limited during March through early June to reduce fry impingement. Fish >60mm passed without injury. **Interim Measure:** PGE will lower diversion canal water elevations to 4.7 feet from February 15 to March 1. Additionally, PGE will lower the canal water elevations to 4.2 feet for 8 hours per day, beginning daily at sunset, March 15 and May 15.	PGE has previously initiated effect minimization actions. ESA Subgroup and PGE successfully negotiated additional effect minimization.
Marmot Diversion Dam Fish Ladder	Habitat Access	**Direct Effect:** Mortality and/or injury of fish occurring within fish ladder. **Indirect Effect:** Upstream migration of adult salmonids may be delayed during high flows, or may be more prone to fallback.	**Relevant Studies:** No evaluation of the performance of the fish ladder has been conducted. The fish ladder was rebuilt in 1983 to agency specifications. All fish are sorted at the ladder and only wild fish are passed upstream. **Interim Measure:** No other physical improvements are necessary for the short-term. However, PGE does commit to maintain the same effort on Operations and Maintenance of the ladder, as described in the current agreement between ODFW and PGE, during the period after their current FERC license expires and before dam removal.	ESA Subgroup and PGE successfully negotiated additional effect minimization.
Marmot Diversion Dam Spillway	Habitat Access	**Direct Effect:** Injury or mortality of outmigrant passing over spillway during high flows.	The dam rebuilt in 1990 was designed to minimize injury to downstream migrating fish.	PGE has previously initiated effect minimization actions.
		Indirect Effect: Releases from spillway may provide attraction for adults to the base of the dam.	**Relevant Studies:** Adult attraction to flow spilled over the dam has not been evaluated.	No effect minimization actions proposed by PGE.
Marmot Diversion Canal	Habitat Access	**Direct Effect:** Fish may be entrained into canal and redirected to the Sandy River, the Little Sandy River, or Roslyn Lake.	**Existing Measure:** Canal has a traveling screen that directs fish into bypass facility. **Short-term:** No change anticipated.	PGE has previously initiated effect minimization actions.

Project Feature/ Proposed Action Effect Pathway/	Indicator	Potential Effects	Proposed Measures and Studies to Address Effects on Listed Salmonids	Rationale for ESA Subgroup Agreement Points for Interim Operations
Little Sandy Diversion Dam	Habitat Access	**Indirect Effect:** Dam currently blocks access to 6.5 miles (10.5 km) of habitat.	There are no documented anadromous fish above this dam, and the cost of reestablishing temporary habitat connection prior to dam removal, would likely be high relative to the benefit gained for fish. To adequately begin to address all impacts at this dam without introducing new impacts would require the establishment of instream flows below the dam and passage facilities for up and downstream migrants. **Short-Term:** No change anticipated.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations.
		Indirect Effect: Isolation of cutthroat populations above dam.		No effect minimization actions proposed by PGE.
	Water Quality	**Indirect Effect:** Reduced flows result in increased temperature downstream of dam.	**Relevant Studies:** PGE collected temperature data. **Short-term:** Project effects on temperature are relatively small and cannot be effectively corrected through operations.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations.
	Habitat Elements	**Indirect Effect:** Diversion of all flows up to 800 cfs limits habitat in Little Sandy and Bull Run Rivers below the dam. Currently no minimum flows.	**Existing Measures:** PGE has an agreement with ODFW to avoid spilling to reduce attraction flows to the Little Sandy River. IFIM has been conducted. Hatchery compensation is conducted in lieu of passage or minimum flows. No flow fluctuations, except during emergency shutdowns.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations.
		Direct Effect: entrainment of cutthroat into Roslyn Lake.	**Short-term:** There is no information on entrainment rates of cutthroat at Little Sandy; and access to the dam is very limited - placement of a scre trap here as a temporary screen would screen very little of the overall diversion and provide little benefit to the fish. No cutthroat are documented in the fishery at Roslyn Lake, hence entrainment rates are likely low.	ESA Subgroup reviewed and determined no additional action was necessary.
		Indirect Effect: Reduced supply of gravel and large woody debris (LWD).	**Short-term:** No change anticipated.	No effect minimization actions proposed by PGE.

Project Feature/ Proposed Action Effect Pathway/	Indicator	Potential Effects	Proposed Measures and Studies to Address Effects on Listed Salmonids	Rationale for ESA Subgroup Agreement Points for Interim Operations
	Flow/ Hydrology	**Indirect Effect:** Ramping (stranding, entrapment, repeated ramping may force juveniles into sub-optimal habitat or early outmigration). **Indirect Effect:** Reduction peak flows.	**Existing Measure:** No flow fluctuations occur, except during emergency shutdowns. **Short-term:** No change anticipated.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations. PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations.
Little Sandy Spillway	Habitat Access	**Indirect Effect:** Spill over the dam may attract adults into the Little Sandy River, where they can be delayed or stranded.	**Existing Measure:** PGE has an agreement with ODFW to avoid spilling to reduce attraction flows to the Little Sandy River. **Short-term:** No change anticipated.	PGE has previously initiated effect minimization actions.
Bull Run Powerhouse	Water Quality	**Indirect Effect:** Routing of flows through the diversion system increases temperature of water released from the powerhouse some times of the year, and decreases it at other times.	**Relevant Studies:** PGE collected temperature data. **Short-term:** Project effects on temperature are relatively small and cannot be effectively corrected through operations. **Short-term:** No change anticipated.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations.
	Habitat Access	**Direct Effect:** Fish entrained into Roslyn Lake experience injury or mortality due to subsequent entrainment into the powerhouse. **Indirect Effect:** Delay of adult upstream migration by false attraction to increased flow and Sandy origin water in the Bull Run River, particularly for spring chinook.	**Short-term:** There is no information on entrainment rates of cutthroat into the Powerhouse. No cutthroat are documented in the fishery at Roslyn Lake, hence entrainment rates are likely low. **Existing Measures:** Tailrace barrier excluded adult salmon from entering the tailrace pool and encourages fish to move downstream back into the Sandy River.	PGE previously reviewed action and determined effects were non-existent or best addressed through status quo operations. ESA Subgroup reviewed and determined no additional action was necessary.
	Habitat Elements	**Indirect Effect:** Habitat may be improved by increased flow into the Bull Run River.	**Relevant Studies:** IFIM has been conducted. **Short-term:** No change anticipated.	No effect minimization actions proposed by PGE.

Project Feature/ Proposed Action Effect Pathway/	Indicator	Potential Effects	Proposed Measures and Studies to Address Effects on Listed Salmonids	Rationale for ESA Subgroup Agreement Points for Interim Operations
	Flow/ Hydrology	**Indirect Effect:** Ramping (stranding, entrainment, repeated ramping may force juveniles into sub-optimal habitat or early outmigration).	**Existing Measures:** PGE has developed plans to reduce flow fluctuations. **Relevant Studies:** PGE is investigating measures to avoid flow fluctuations; however, appropriate habitat in the Bull Run River is largely limited by upstream activities that are outside the scope of this action.	No effect minimization actions proposed by PGE.

[1]The affected listed, proposed, and candidate salmonid ESUs affected are the Lower Columbia River Chinook Salmon ESU, the Lower Columbia River/Southwest Washington Coast Coho Salmon ESU, and the Lower Columbia River Steelhead ESU. The Southwestern Washington/Columbia River Coastal Cutthroat Trout DPS was considered, but is not currently listed.

APPENDIX B

Sandy River ESA Fish Monitoring and Contingencies Plan

Issue	Area Affected	Species/Lifestage Affected and Run Timing	Monitoring	Contingency Trigger (duration/timing/ magnitude of impact)	Contingency (action to be performed)	Potential ESA Take Issues
Fish Passage: Blockage to upstream fish passage due to sediment deposition issues, either as a structural obstruction or high velocity areas over long distances. Also includes side channel problems	Reach 0 Reach 1	Spring Chinook Adults (Apr-Nov with peak in June-Sept). Winter Steelhead Adults (Nov- May with peak in Feb-Apr). Coho Adults (Sept-Dec with peak in Sept-Nov). Bull Trout[4]	1. Monitor integrity of cofferdam during **in-water work period (July-Oct)** dam removal operations, prior to fall rains - if in-water work period breaching of cofferdam occurs, visual monitoring action required 5 days/week to identify any potential passage problems until fall high flows begin. Fish Passage monitoring will then follow #2-4, below. 2. From high-flow breaching of the cofferdam to Feb 15 of the following year: Monitor one day/week [additional monitoring day(s) necessary if barrier detected to determine if barrier exists for 2 days]. 3. Regular monitoring (5 days/week) will occur from Feb 15 to Nov 30 in the year following dam removal to identify any potential passage problems. 4. Members of the Monitoring Implementation Team (MIT)[2] shall participate in an initial monitoring trip to ensure monitoring methodologies are field-tested for both visual observations and passage barrier data collection. MIT members also shall occasionally participate in monitoring activities. 5. After the first year of post-dam removal Fish Passage monitoring, the MIT will refine the frequency of Fish Passage monitoring events.	**In-water Work Period Breaching (during Marmot Dam removal period) and Post-Dam Removal Periods:** 1. Complete structural blockage or other migratory barrier, as defined by ESA sub-team criteria[1], for over 2 days during **peak migration**. If visual monitoring observations by PGE (or other party) indicate potential existence of a migratory barrier, site-specific passage barrier data (see footnote 1) will be collected by PGE and recorded. 2. Complete structural or other migratory barrier as defined by ESA sub-team criteria for over 2 days during **non-peak migration**. If visual monitoring observations by PGE (or other party) indicate potential existence of a migratory barrier, site-specific passage barrier data (see footnote 1) will be collected by PGE and recorded.	Once a Contingency Trigger is identified via Monitoring, the run-timing of listed ESA fish species will dictate the type of Contingency response. **Peak Migration Period Fish Passage Problem:** After two days of passage blockage, the blockage will require immediate contingency action. PGE will notify all MIT members within 12 hours, and solicit Contingency guidance. PGE will implement contingency options recommended by resource agency MIT members. However, if no resource agency input is available, PGE will select and implement a Contingency Option (see Contingency Options, below). During and after passage blockage removal activities, PGE shall report the actions taken and results of those actions to the MIT and make adjustments to implementation according to recommendations of resource agencies. This "feedback loop" provides the MIT with information to determine if the passage blockage has been successfully addressed or whether PGE must take additional passage blockage actions. **Non-Peak Migration Period Fish Passage Problem:** After two days of passage blockage, the blockage will be immediately reviewed by the MIT with a decision on whether or not a contingency action is necessary during the non-peak migration period. The MIT will consider the magnitude and circumstances of the blockage, the species/ lifestages present at the time, fish maturation, run strength, likely flow events and weather conditions, water quality, and any other environmental factors deemed relevant. If the MIT determines that a contingency action is required, the MIT will notify PGE of the requirement to alleviate the Fish Passage problem. The MIT also will recommend the action to be taken by PGE (see Contingency Options, below). During and after passage blockage removal activities, PGE shall report the actions taken and results of those actions to the MIT. This "feedback loop" provides the MIT with information to determine if the passage blockage has been successfully addressed or whether PGE must take additional passage blockage actions. **Contingency Options**[3]: 1. Mechanically remove structural blockage when instream work can be accomplished safely. 2. Add instream channel complexity (i.e., anchored logs) to increase channel roughness and create velocity breaks. (Note: instream channel complexity action is a temporary, single season action, not a permanent, hardened feature). 3. Emergency salvage and transport of fish. 4. Rapid deployment of a trap and haul facility.	Take likely to occur from passage delay or blockage: migration delay, high turbidity, poor holding conditions, etc.

Issue	Area Affected	Species/Lifestage Affected and Run Timing	Monitoring	Contingency Trigger (duration/timing/ magnitude of impact)	Contingency (action to be performed)	Potential ESA Take Issues
	Reach 2		No regularly scheduled monitoring. Opportunistic visual observations during overflights.	Any blockage to be reported to and discussed by MIT.	Unknown, as Reach 2 is unaccessible.	
	Reach 3	Spring Chinook Adults (Apr-Nov with peak in June-Sept). Winter Steelhead Adults (Nov-May with peak in Feb-Apr). Coho Adults (Sept-Dec with peak in Sept-Nov). Fall Chinook Adults (Aug-Dec with peak in Oct-Nov). Bull Trout	1. **During low flow periods (Aug-Oct)**: Monitor fish passage problems during receding hydrograph at 100 cfs increments, based on Sandy R gage above Bull Run, from ~600 cfs down to 400 cfs. One monitoring check in Reach 3 per each 100 cfs increment. Increases in flow over 600 cfs during Aug-Oct resets the monitoring schedule described above. 2. **Any time of year:** Monitor once for all fish passage problems and stranding in side channels after flows recede from each 3000 cfs (or greater) events to lower, base levels. Monitoring to occur as water levels recede with initial visual determination of whether a blockage was created by sediment movement during 3,000+cfs flow event.	**Dry-period Breaching (during Marmot Dam removal period) and Post-Dam Removal Periods:** 1. Complete structural blockage or other migratory barrier, as defined by ESA sub-team criteria,[1] for over 2 days during **peak migration**. 2. Complete structural or other migratory barrier, as defined by ESA sub-team criteria, for over 2 days during **non-peak migration**. 3. Upstream blockage of side channel access, with potential to falsely attract and strand fish into the lower portion of that side channel **during any migration period.** 4. Actual stranding of adults or juveniles in side channels **during any migration period.**	Once a Contingency Trigger is identified via Monitoring, the run-timing of listed ESA fish species will dictate the type of Contingency response. For structural blockage or other migratory barrier during **peak** migration, the same process as described above for Reaches 0 and 1 "**Peak** Migration Period Fish Passage Problem" (above) shall occur. For structural blockage or other migratory barrier during **non-peak** migration, the same process as described above for Reaches 0 and 1 "**Non-Peak** Migration Period Fish Passage Problem" (above) shall occur. For upstream blockage of side channel access, or actual stranding of adults or juveniles, the same process as described above for Reaches 0 and 1 "**Non-Peak** Migration Period Fish Passage Problem" (above) shall occur. **Contingency Options**: 1. Mechanically remove side channel blockage if feasible. 2. Add instream channel complexity (i.e., anchored logs) to increase channel roughness and create velocity breaks (Note: instream channel complexity action is a temporary, single season action, not a permanent, hardened feature.) 3. Emergency salvage of fish if fish become stranded in side channels. 4. Rapid deployment of trap and haul facility.	Reach 3 rationale: concerns are main channel blockage in upper reach, and upstream blockage of a side channel. Anticipate main channel will remain passable in lower Reach 3. Side channel may cause "attractive nuisance," create stranding. As hydrograph descends, stranding potential increases.

Issue	Area Affected	Species/Lifestage Affected and Run Timing	Monitoring	Contingency Trigger (duration/timing/ magnitude of impact)	Contingency (action to be performed)	Potential ESA Take Issues
	Reach 4 and 5	Spring Chinook Adults (Apr-Nov with peak in June-Sept). Winter Steelhead Adults (Nov-May with peak in Feb-Apr). Coho Adults (Sept-Dec with peak in Sept-Nov). Fall Chinook Adults (Aug-Dec with peak in Oct-Nov). Bull Trout	1. **During low flow periods (Aug-Oct)**: Monitor fish passage problems during receding hydrograph at 100 cfs increments, based on Sandy R gage above Bull Run, from ~600 cfs down to 400 cfs. One monitoring check in Reaches 4 and 5 per each 100 cfs increment. Increases in flow over 600 cfs during Aug-Oct resets the monitoring schedule described above. 2. **Any time of year:** Monitor once for all fish passage problems and stranding in side channels after flows recede from each 3000 cfs (or greater) events to lower, base levels. Monitoring to occur as water levels recede with initial visual determination of whether a blockage was created by sediment movement during 3,000+cfs flow event.	**Dry-period Breaching (during Marmot Dam removal period) and Post-Dam Removal Periods:** 1. Complete structural blockage or other migratory barrier, as defined by ESA sub-team criteria,[1] for over 2 days during **peak migration**. 2. Complete structural or other migratory barrier, as defined by ESA sub-team criteria, for over 2 days during **non-peak migration**. 3. Upstream blockage of side channel access, with potential to falsely attract and strand fish into the lower portion of that side channel **during any migration period.** 4. Actual stranding of adults or juveniles in side channels **during any migration period.**	Once a Contingency Trigger is identified via Monitoring, the run-timing of listed ESA fish species will dictate the type of Contingency response. For structural blockage or other migratory barrier during **peak** migration, the same process as described above for reaches 0 and 1 "**Peak** Migration Period Fish Passage Problem" (above) shall occur. For structural blockage or other migratory barrier during **non-peak** migration, the same process as described above for reaches 0 and 1 "**Non-Peak** Migration Period Fish Passage Problem" (above) shall occur. For upstream blockage of side channel access, or actual stranding of adults or juveniles, the same process as described above for reaches 0 and 1 "**Non-Peak** Migration Period Fish Passage Problem" (above) shall occur. **Contingency Options**: 1. Mechanically remove side channel blockage if feasible. 2. Add instream channel complexity (i.e., anchored logs) to increase channel roughness and create velocity breaks (Note: instream channel complexity action is a temporary, single season action, not a permanent, hardened feature.) 3. Emergency salvage of fish if fish become stranded in side channels. 4. Rapid deployment of trap and haul facility.	Main concern in Reach 4: side channel stranding.
	All rreaches: especially reservoir area, Reaches 1 and 3	Outmigrating juvenile salmonids (Feb 15-June 30)	Covered by monitoring actions for Passage in Reaches 0-5.			
Tributary Blockage: Sediment moving downstream will block entrances to side channels and tributaries. NOTE: side channels are addressed in Fish Passage	Reach 0, 1 and 2 have no tributaries for anadromy					
	Reach 3 Cedar Creek, which already has passage problems at low flows.	All migrating salmonids Hatchery fish (up and downstream)	Check Cedar Creek confluence with Sandy R, concurrent with Reach 3 Fish Passage monitoring [above]. Monitoring occurs during descending Sandy R flows [between 600 to 400 cfs in 100 cfs increments] as well as after high flow [3,000 cfs] events.	Complete blockage, as defined by ESA sub-team criteria, of Cedar Creek access.	Mechanical removal of blockage if feasible. Blockage at Cedar Creek requires immediate action to reopen access, and thereby minimize straying of hatchery fish.	Broad, shallow sheet flow or subsurface flow at tributary mouth during low Sandy River flow periods, or blockage after high-flow event.

Issue	Area Affected	Species/Lifestage Affected and Run Timing	Monitoring	Contingency Trigger (duration/timing/ magnitude of impact)	Contingency (action to be performed)	Potential ESA Take Issues
	Reach 4 Bull Run River Trout Creek Gordon Buck	All salmonids (all months) STH, CUTT, CHIN FCHIN COHO, STH, CUTT FCHIN, COHO, STH, CUTT COHO	Check tributary confluences with Sandy R, concurrent with Reach 3 Fish Passage monitoring [above]. Monitoring occurs during descending Sandy R flows [between 600 to 400 cfs in 100 cfs increments] as well as after high flow [3,00 cfs] events.	Complete blockage, as defined by ESA sub-team criteria, of tributary access for over 2 days.	Once a potential tributary passage problem is identified, the MIT will immediately be contacted. The MIT will consider the blockage, timing of next flow event, species/lifestages present at the time, fish maturation, run strength, migration periodicity, water quality, and importance of habitat, to determine if additional response is necessary. If the MIT determines that a contingency action is required, the MIT will notify PGE of the requirement to alleviate the Tributary Blockage problem. The MIT also will recommend the action to be taken by PGE (see Contingency Options under Fish Passage, above).	Main concern is access to tributaries is maintained during peak migrations (both up and down stream).
	Reach 5 Braided channels Beaver (potential habitat restoration)	All salmonids COHO/STEELHEAD	Check Beaver Creek confluence and braided channel areas in Sandy R, concurrent with Reach 3 Fish Passage monitoring [above]. Monitoring occurs during descending Sandy R flows [between 600 to 400 cfs in 100 cfs increments] as well as after high flow [3,000 cfs] events.	Complete blockage, as defined by ESA sub-team criteria, of tributary access for over 2 days.	Once a potential tributary passage problem is identified, the MIT will immediately be contacted. The MIT will consider the blockage, timing of next flow event, species/lifestages present at the time, fish maturation, run strength, migration periodicity, water quality, and importance of habitat, to determine if additional response is necessary. If the MIT determines that a contingency action is required, the MIT will notify PGE of the requirement to alleviate the Tributary Blockage problem. The MIT also will recommend the action to be taken by PGE (see Contingency Options under Fish Passage, above).	
Sediment Deposition at Mouth of Sandy: (esp sand and during low flow periods) may prevent fish passage	Reach 5	All salmonid lifestages during low flow periods	Check Sandy River delta at low flows as hydrograph drops from 600 to 400 cfs in 100 cfs increments (gaged above Bull Run) and after >3,000 cfs events.	Blockage, based on ESA sub-team criteria, of up and downstream fish passage from the Columbia River.	Once a Sediment Deposition at Mouth of Sandy problem is identified, the MIT will immediately be contacted. The MIT will consider the blockage, timing of next flow event, species/lifestages present at the time, fish maturation, run strength, migration periodicity, water quality and importance of habitat, to determine if additional response is necessary. If the MIT determines that a contingency action is required, the MIT will notify PGE of the requirement to alleviate the Sediment Deposition at Mouth of Sandy problem. The MIT also will recommend the action to be taken by PGE (see Contingency Options under Fish Passage, above).	Reach 5: sand deposition below I-84 bridge that creates an impassable sand bar during low summer/ fall baseflows. Need to ensure there is a single passable mainstem channel for fish to pass.

Issue	Area Affected	Species/Lifestage Affected and Run Timing	Monitoring	Contingency Trigger (duration/timing/ magnitude of impact)	Contingency (action to be performed)	Potential ESA Take Issues
Sediment Deposition over Spawning Beds: existing redds buried by sediment moving downstream	Reach 1 and 2	None	None			
	Reaches 3, 4 and 5	Incubating fall Chinook (Sept-Jan) Incubating winter steelhead (Apr - 15 July)	None under ESA fish requirements			Deposition of sediments over existing mainstem Sandy River salmonids redds after Marmot Dam is removed. Deposition may cause loss of eggs/alevins. Impact believed to be limited to season following dam removal.
Loss of Mainstem Habitat for juvenile fish:	Reaches 0, 1 and 2	All salmonids	Monitor side channel blockage as per Fish Passage monitoring, above	Identify if side channels are non-usable	Once a potential side channel problem is identified, the MIT is to consider the fish usage, blockage, timing of next flow event, migration periodicity, importance of habitat and water quality to determine course of action, if any. The MIT also will recommend the action to be taken by PGE (see Contingency Options under Fish Passage, above).	Potential take issue-adverse modification. - However, passage is a greater concern in Reach 0-2.
	Reach 3, 4, 5	All salmonids	Monitor side channel blockage as per Fish Passage monitoring, above	Identify if side channels are non-usable	Once a potential side channel problem is identified, the MIT is to consider the fish usage, blockage, timing of next flow event, migration periodicity, importance of habitat and water quality to determine course of action, if any. The MIT also will recommend the action to be taken by PGE (see Contingency Options under Fish Passage, above).	Potential take issue-adverse modification. Loss of habitat is a larger concern than mainstem passage in Reaches 3-5.
Water Quality Issue: **Sedimentation**	0,1,3, possibly 2,4,5	All salmonids	None.	Contingency Trigger: same as fish passage & habitat issues	Contingencies: same as fish passage & habitat issues	Passage blockage, loss of redds

Issue	Area Affected	Species/Lifestage Affected and Run Timing	Monitoring	Contingency Trigger (duration/timing/ magnitude of impact)	Contingency (action to be performed)	Potential ESA Take Issues
Turbidity and/or TSS: post-construction	0-5; and potentially Columbia River in plume	All salmonids.	As identified in the ODEQ turbidity monitoring plan.	Delay in passage into tributaries (see monitoring action under Tributary Blockage Issue, above)	Ensure tributaries are not blocked for fish so they can move into tributaries to avoid turbid conditions (linked to the tributary passage monitoring and contingencies).	Potential ESA take due to turbidity/total suspended sediments.

[1]ESA Sub-team Criteria identifying potential blockages in the mainstem:
Length: A passage barrier exists if:
Length of blockage is greater than 300' and velocity greater than 2 ft/sec
Length of blockage is greater than 200', less than 300', and velocity greater than 3 ft/sec
Length of blockage is greater than 150', less than 200', and velocity greater than 4 ft/sec
Length of blockage is greater than 100', less than 150', and velocity greater than 5 ft/sec
Length of blockage is greater than 50', less than 100', and velocity greater than 6 ft/sec
Length of blockage is greater than 20', less than 50', and velocity greater than 8 ft/sec
Length of blockage is less than 20' and velocity greater than 11 ft/sec
Depth: A passage barrier exists if:
Migratory channel must have at least a 10" deep thalweg (deepest portion of cross section) to be considered passable
Height: A passage barrier exists if:
Jump pool shallower than jump height
Jump height is greater than 4'

[2]An ESA Monitoring Implementation Team (MIT), as described in Section 7.3 of the Decommissioning Plan, would be established to oversee the Sandy River ESA Fish Monitoring and Contingencies Plan (ESA Fish Plan).

[3]Mechanical Removal, Channel Complexity Enhancement, Emergency salvage, and Trap and Haul are described in Section 4.6 of the Decommissioning Plan.

[4]Bull trout will also be protected via this ESA monitoring and contingencies plan. Bull trout are not known to currently reside in the Sandy River Basin, but are occasional migrants into the Sandy River Basin from other Columbia River tributaries.